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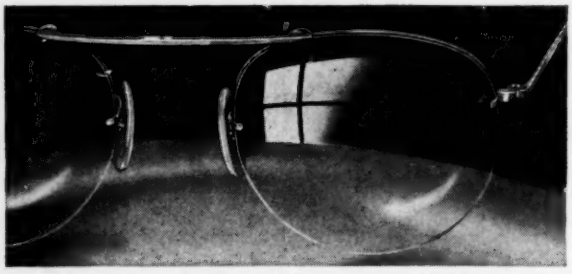

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AMERICAN JOURNAL OF OPHTHALMOLOGY

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THE CLINICAL COURSE OF GLAUCOMA*

A REVIEW OF 474 CASES FROM PRIVATE PRACTICE

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New York

It is well known that the clinical course of primary glaucoma shows great variability from patient to patient. At one extreme, the disease is so mild that the diagnosis cannot be made with certainty except after long periods of observation. At the other extreme are those malignant cases which progress rapidly and inexorably to ultimate blindness within six months or a year. The majority of glaucoma patients fall somewhere between these two extremes.

The present study is a correlation of 474 glaucoma cases from private practice, of which 373 are primary glaucoma. Of these, 158 patients have been followed for 5 years or longer and 21 of these have been observed for 20 years or longer (fig. 1). Such cases, representing as they do, the life-cycle of the disease, can add greatly to our understanding of the nature of glaucoma. These studies are all the more valuable since they are based on carefully kept and richly annotated records which are the legacy of the late Dr. Mark J. Schoenberg. Shorter case histories have been included mainly to enhance the statistical value of this study.

The available material was correlated analytically to uncover the many variations in the symptomatology and course of the disease. An attempt was then made to synthesize these findings so as to achieve a better understanding of the many-faceted clinical picture of primary glaucoma. The ophthalmologist's experience with an individual case may be limited to only one stage in the life cycle of the disease. We hope that this paper will aid him in the evaluation of the past history of the case and in the formulation of a plan of treatment.

INCIDENCE

The exact incidence of primary glaucoma in the general population is unknown. It has been estimated that from 0.5 percent to 2 percent of all patients consulting ophthalmologists or clinics, suffer from glaucoma. According to Carvill[1] 1.33 percent of all the new patients attending the Massachusetts Eye and Ear Infirmary between 1928 and

TIME UNDER OBSERVATION

No. of years under observation	Primary glaucoma	Indeterminate group
5-10	72	3
11-15	36	4
16-20	22	
21-25	14	1
26-34	5	1
TOTAL 5-34	149	9

Fig. 1 (Posner and Schlossman). One hundred fifty-eight patients have been followed for five years or longer.

* Presented at the III Pan-American Congress of Ophthalmology, Havana, Cuba, January 8, 1948.

1930 had glaucoma; 57 percent of these were primary. Lehrfeld and Reber[2] give the incidence of glaucoma at the Wills Eye Hospital between 1926 and 1935 as 0.78 percent. This figure includes both primary and secondary glaucoma. In our series the incidence of primary glaucoma among 12,000 case histories was 3.1 percent.

Classification

The most widely accepted classification divides glaucoma into three types: acute congestive, chronic congestive, and chronic simple. Other classifications were proposed at various times. Von Graefe[3] recognized acute and chronic inflammatory glaucoma as well as another disease which he called "amaurosis with excavation." The last named group probably contained many cases of chronic simple glaucoma in addition to those of glaucoma without hypertension. Heerfordt[4] divided glaucoma into "haemostatic" and "lymphostatic" forms; but this classification was not widely accepted because it contained etiologic implications which were not well founded. Elschnig[5] substituted the terms "compensated" and "incompensated" glaucoma for the chronic simple and congestive forms, respectively. This terminology is confusing, since most cases of chronic simple glaucoma are, in the physiologic sense, incompensated.

Raeder,[6] in 1923, proposed a classification of glaucoma based on the depth of the anterior chamber. More recently, this idea was elaborated by Barkan,[7] Sugar,[8] and Kronfeld[9] with the aid of gonioscopy. In this country the terms "narrow" and "wide-angle" glaucoma have almost supplanted all other terminologies. While every new line of approach in the study of glaucoma is a distinct contribution toward the ultimate solution of this baffling problem, we feel that the present state of our knowledge does not warrant the adoption of an etiologic classification.

The term "narrow-angle glaucoma" is based on the assumption of the iris block mechanism as the primary cause of this form of the disease. In "wide-angle glaucoma" the implication is made that the trabeculum-canal of Schlemm apparatus is, in some way, the primary offender. It is apparent that these two mechanisms are not mutually exclusive. Individuals who have eyes with narrow angles may develop disturbances in the trabeculum or elsewhere in the eye of a type similar to that found in the "wide-angle" glaucoma. A case of this sort cannot be classified except on the basis of its clinical picture.

We believe with Troncoso[10] that "shallowness of the angle should be considered as a predisposing and not . . . as the primary cause of hypertension." It is true that in some eyes with narrow angles, mydriasis may cause closure of the angle and thus precipitate an acute attack. Even here we do not know to what extent other factors are responsible for the rise of tension.

Bangerter and Goldmann[11] have called attention to the fact that, while 18 percent of normal eyes have narrow angles and 22 percent have wide angles, as many as 60 percent fall into an intermediate group. Since the incidence of glaucoma of all forms is 0.5 to 3 percent of all eye patients (the congestive type representing about one third of the total), a very small percentage of eyes with narrow angles develop glaucoma.

We have observed several cases with wide angles who were subject to acute attacks. The regular use of miotics does not necessarily prevent congestive attacks. On the contrary, we have gained the impression that, in some cases, the prolonged use of pilocarpine, while it lessens the frequency, increases the severity of attacks. Homatropine frequently fails to provoke an attack in the narrow angle type, and, furthermore, it occasionally produces a congestive attack in a case of chronic simple glaucoma with an intermediate or wide angle.[10] In two cases, whose angles are wide at present, the dis-

ease was ushered in with an acute attack. Ten-percent neosynephrine has been used by us even in chronic congestive glaucoma without increasing the tension. In fact, it may make the eye more responsive to the subsequent use of pilocarpine.[12] Hamburger[13] has made the same observation with regard to glaucosan. In certain cases, the pupil remains widely dilated following an acute attack, and yet the tension remains normal, either with or without the use of miotics.

We have adopted the classical nomenclature of acute congestive, chronic congestive, and chronic simple glaucoma, since it carries no etiologic implications and is based on the clinical course of the disease. The diagnosis of acute glaucoma was made when the patient had only one congestive attack, or a second one after many years. Recurrent ocular pain or congestion determined the diagnosis of chronic congestive glaucoma. A case was classified as chronic simple glaucoma even when colored halos and slight discomfort were occasionally present.

In our series of 373 cases of primary glaucoma, 152 were males and 221 were females (fig. 2). In terms of eyes, the total number

TOTAL NUMBER OF PATIENTS

TYPE	TOTAL	MALE	FEMALE
PRIMARY GLAUCOMA	373	152	221
SECONDARY GLAUCOMA	76	36	40
INDETERMINATE GROUP	25	12	13
TOTAL	474	200	274

Fig. 2 (Posner and Schlossman). Incidence of sex in the cases studied.

was 657 eyes (some cases were monocular), of which the males represented 262 and the females 395. The preponderance of women is much more pronounced in the congestive types, where the ratio is 64 male eyes to 171 female eyes (fig. 3).

In attempting to separate the chronic simple from the chronic congestive forms, it was often difficult to make a decision in borderline cases. In view of the fact that the subjective reaction to ocular disturbances varies widely with the psychic makeup of the individual, the use of subjective criteria, such as pain and congestion, may have led to the inclusion in the chronic simple group of some patients who actually suffered from chronic congestive glaucoma or a combination of the two forms. For example, some of the patients had no symptoms at first, but after treatment began to have ocular discomfort or to see occasional halos. The only patients whom we can classify with certainty as chronic simple glaucoma are those who never showed any symptoms except for the loss of field. It is interesting to note that in this group the sex distribution is equal (77 females to 77 males). Thus, even in the chronic simple form, the preponderance of females may be due to the inclusion of cases which have a congestive element in them. The higher incidence of congestive attacks in females may

EYES WITH PRIMARY GLAUCOMA

TYPE	MALE	FEMALE
Acute congestive	10	61
Chronic congestive	44	96
Chronic simple & congestive attacks	10	14
TOTAL CONGESTIVE	64	171
Chronic simple & symptoms	121	147
Chronic simple & symptoms	77	77
TOTAL CHR. SIMPLE	198	224

Fig. 3 (Posner and Schlossman). The congestive form shows a predominance of females over males, while chronic simple glaucoma without symptoms is equally distributed between the sexes. The slight predominance of females over males in the total group of chronic simple glaucoma indicates that some of these cases may exhibit a congestive element.

be related to their generally more labile vasomotor reactions.

Among the cases which were observed for five years or longer, many followed a clinical course which did not fit into any single category of our classification. Some of them behaved like chronic simple glaucoma but had one or more congestive attacks, either spontaneously while under treatment, or after the use of atropine or homatropine. In several cases the disease was initiated following the use of a mydriatic, either for refraction or in the treatment of a corneal ulcer; yet the subsequent course assumed the characteristics of chronic simple glaucoma. In other cases the disease began as asymptomatic glaucoma, but congestive attacks made their appearance after the prolonged use of miotics. In one case the acute attack occurred in connection with childbirth. Schmidt-Rimpler[14] has called attention to this group and has named it "glaucoma simplex with intermittent congestive attacks." We feel that the term is descriptive and we have adopted it in our classification. This group comprises 18 patients with a total of 24 affected eyes.

MIXED GROUP

FIRST EYE	SECOND EYE	No. OF CASES
CONGESTIVE	CHR. SIMPLE	18
CHR. SIMPLE & CONG. ATTACKS	CHR. SIMPLE	9
CHR. SIMPLE & CONG. ATTACKS	ACUTE CONG.	1
CHR. SIMPLE & CONG. ATTACKS	SAME	6
CHR. SIMPLE & CONG. ATTACKS	NORMAL	2

Fig. 4 (Posner and Schlossman). This "mixed group" of cases emphasizes the importance of an extended and careful study of the life history of a patient with glaucoma.

There were 28 cases in which one eye suffered from glaucoma of a type different from the other. In 18 of these, one eye had chronic simple glaucoma and the other congestive glaucoma. In 9 cases, one eye had chronic simple glaucoma and the other chronic simple glaucoma with congestive attacks. In one case, one eye suffered from chronic simple glaucoma with congestive attacks while the other had congestive glaucoma. This group of cases, together with the cases of chronic simple glaucoma with congestive attacks referred to in the previous paragraph, form a "mixed group" which is shown in Figure 4.

This "mixed group" of cases emphasizes the importance of an extended and careful study of the life history of a patient with glaucoma. In some instances, it may be necessary to defer classifying a case for several years until its true nature is revealed. At times, it may even be impossible to place a given case of glaucoma in any single category. This brings up the question, whether primary glaucoma should be considered as a single disease or as several diseases. It is possible that, with further advances in our knowledge, different cleavage lines will be used in the classification of glaucoma. In the light of our present information, however, the classification which we adopted is a practical one in that it offers the clinician a means of segregating his cases for therapeutic and prognostic purposes. In a future paper we hope to present some typical life histories of glaucoma patients, so as to give a more concrete basis for the evaluation of the various clinical pictures.

In following a case of glaucoma, it is important to obtain a detailed account of the patient's symptoms, and to record it, preferably in the patient's own words. The history may be the only clue to the diagnosis in many cases, especially in the congestive form during the glaucoma-free interval. These patients may present themselves immediately after a mild attack when the tension in the affected eye frequently drops to a lower level than that of the other eye. At this time, even provocative tests may give nega-

tive results. In this connection we would like to remark that pupillography may represent the only confirmatory evidence. One patient was carried for over a year by several ophthalmologists as a psychoneurotic, because the tension of his eye was always taken after a mild attack and found to be low normal.

Monocular cases

Our experience with the mixed group of glaucoma cases has forced the conclusion upon us that one cannot assume that both eyes will necessarily develop the same type of glaucoma or that they will show identical responses to miotics, surgery, or provocative tests. Even the gonioscopic appearance may be different in the two eyes. This lack of parallelism between the two eyes is graphically demonstrated by the comparatively large number of monocular cases which constitute 18 percent of the total (fig. 5). The incidence of monocular glaucoma was more than three times as great in the congestive (31 percent) types as in chronic simple (9.6 percent) type. The reasons for these differences are obscure, but some clinical evidence is available to permit a tentative explanation. Pupillographic studies have shown that even the monocular cases probably represent a binocular disturbance, since the pupillary reaction-curve is similar in the two eyes.[15] Mydriatics, acute disease, pregnancy, surgical procedures (ocular or general), emotional disturbances, trauma, excessive reading, movies, card playing, and occasionally even miotics may provoke a congestive attack. These precipitating factors probably act indirectly by disturbing the balance of the autonomic nervous system. It is possible that in chronic simple glaucoma the tension-regulating mechanism has achieved a certain degree of stability, although, of course, at a higher level, and hence is not apt to respond violently to disturbances of the autonomic nervous system.

MONOCULAR AND BINOCULAR CASES OF PRIMARY GLAUCOMA

	CONGESTIVE		CHRONIC SIMPLE		TOTAL	
	No.	%	No.	%	No.	%
MONOCULAR	49	31	20	9.6	69	18
BINOCULAR	108	69	188	90.4	296	82
TOTAL	157	100	208	100	365	100

Fig. 5 (Posner and Schlossman). The incidence of monocular glaucoma was more than three times as great in the congestive types as in the chronic simple.

In the congestive form, on the other hand, the tension-regulating mechanism is only occasionally embarrassed as a result of the aforementioned provocative factors. It may be assumed that there exists a threshold of vasomotor irritability which has to be passed before the disturbance of the equilibrium can provoke a congestive attack. This is independent of the tension because the degree of congestive symptoms need not be directly proportional to the height of the tension. Cases are observed in which the tension is over 70 mm. Hg (Schiøtz); yet congestive

AGE OF ONSET IN PATIENTS WITH PRIMARY GLAUCOMA

AGE	ACUTE CONGEST.	CHRONIC CONGEST.	MIXED GROUP	TOTAL CONGEST.	CHRONIC SIMPLE	TOTAL CASES
UNDER 20	1			1		1
21–25		1	2	3	1	4
26–30					3	3
31–35	1	1	3	5	10	15
36–40	2	12	2	16	15	31
41–45	5	10	4	19	28	47
46–50	5	11	6	22	34	56
51–55	4	13	9	26	37	63
56–60	6	13	5	24	31	55
61–65	5	12	2	19	26	45
66–70	2	3	2	7	11	18
71–75		2	1	3	9	12
76–80	8	2		10	1	11
81–85		1		1	1	2
86–90	1			1	1	2
TOTAL	40	71	36	157	208	365

Fig. 6 (Posner and Schlossman). The largest number of acute congestive glaucomas in any single 5-year period occurred between the ages of 76 and 80 years.

symptoms are entirely lacking. On the other hand, severe congestive attacks may be accompanied by tensions no higher than 35 mm. or 40 mm. Hg (Schiøtz).

Bloomfield[16] has shown that there is a deficiency of cholinergic substance in the aqueous of glaucomatous eyes. Pilocarpine, in addition to its effect on the tension, conserves this substance and raises the threshold of vasomotor irritability. Consequently, it lessens the frequency of attacks. The observation was made in 15 instances that the institution of treatment with pilocarpine was paradoxically followed by the appearance of acute attacks in previously asymptomatic forms of glaucoma. In some patients who

suffered from frequent mild attacks, miotic therapy decreased the frequency but increased the severity of the attacks to the extent that it was necessary to resort to surgical intervention.

This concept of a threshold explains the prevalence of monocular cases in congestive glaucoma. Even though the disturbance is present in both eyes (cf. pupillography) the threshold is exceeded only in one eye, in which case the other eye appears clinically normal. When the vasomotor imbalance becomes great enough to exceed the threshold, it probably acts like a trigger mechanism to set off a congestive attack. All this indicates that in chronic simple glaucoma the disturbance of the ocular and autonomic equilibrium is more stable, but at the same time more deeply rooted, than in the congestive forms.

Age incidence

The age of onset is shown in Figure 6. This table points out that 79 percent of cases began between the ages of 36 and 65 years. The drop in incidence in the higher age groups is less marked than appears in the figure, because of the progressive decrease in population in the higher age groups. In this connection, it may be significant that the largest number of acute congestive glaucomas in any single 5-year period occurred between the ages of 76 and 80 years. With this exception, the age incidence is approximately the same in congestive as in chronic simple glaucoma.

REFRACTIVE STATUS

REFRACTIVE ERROR (IN DIOPTERS)	EYES WITH CONGESTIVE GLAUCOMA	EYES WITH CHRONIC SIMPLE GLAUCOMA
PLANO	15	38
+.25 to +.50	25	44
−.25 to −.50	4	15
+.75 to +1.50	47	75
−.75 to −1.50	13	20
+1.75 to +3.00	29	50
−1.75 to −3.00	11	21
GREATER THAN +3.00	38	44
−3.00 to −6.00	7	27
GREATER THAN −6.00		15

Fig. 7 (Posner and Schlossman). The spherical equivalents shown above were used in tabulating the refractive errors of 538 eyes.

Refractive status

The refractive errors of 538 eyes were tabulated in groups, using spherical equivalents as shown in Figure 7. In order to be able to compare the relative frequency of the refractive states with those found in the general population, the figure was arranged to conform with the scheme used by Jack-

REFRACTIVE ERROR IN DIOPTERS	CONGESTIVE		CHRONIC SIMPLE		TOTAL GLAUCOMA		NORMAL (JACKSON)	
	No.	%	No.	%	No.	%	No.	%
EMMETROPIA (−.50 to +.50)	44	23.3	114	27.8	141	26.2	—	12.4
HYPEROPIA above +.50	114	60.3	169	48.4	283	52.6	—	70.4
MYOPIA above −.50	31	16.4	83	23.8	114	21.2	—	17.2

Fig. 8 (Posner and Schlossman). Summary of refractive status as compared with Jackson's normals for the general population.

son.[17] He regards as emmetropic all errors between −0.50 and +0.50. Figure 8 shows that there were 52.6-percent hyperopic eyes and 21.2-percent myopic eyes in our cases of primary glaucoma. Jackson finds, for the general population, in the age group between 30 and 40 years, 70.4-percent hyperopes and 17.2-percent myopes. In the congestive group, there is a slightly higher percentage of hyperopic eyes than in chronic simple glaucoma, though the ratio of myopes to hyperopes still follows closely the normal distribution. It is apparent that a myope is just as susceptible to glaucoma as a hyperope. These conclusions agree with those of Loehlein[18] and Holst.[18a]

INCIDENCE OF HEREDITARY CASES

NUMBER OF EYES

CASES	CONGESTIVE AND MIXED	SIMPLE	TOTAL
OVERALL	235	422	657
HEREDITARY	35	53	88

Fig. 9 (Posner and Schlossman). All forms of glaucoma are represented in the hereditary group and they do not differ clinically from the nonhereditary group.

Of the 114 myopic eyes, 49 showed errors greater than −3.0D., and 15 of these had a myopia higher than −6.0D. These very high myopes were found only among patients with chronic simple glaucoma. Arnold Knapp[19] described 33 cases of glaucoma in high myopes and called attention to the fact that in these cases the tension tends to be low, even though the field deteriorates. Our experience corroborates his observations.

Hereditary glaucoma

Hereditary factors are present in many metabolic and nervous diseases, and glaucoma is no exception. The present study reveals 50 patients in 29 different families who had one or more relatives affected with primary glaucoma. This represents 13 percent of all cases of primary glaucoma. The total known number of affected patients in the 29 families is 100 (figs. 9 and 10). While in most families all of the members are affected with the same type of glaucoma, there are exceptions to this rule. All forms of glaucoma are represented in the hereditary group and they do not differ clinically from the nonhereditary forms.

Since 1842, when Benedict first called attention to the familial aspects of the disease, approximately 90 pedigrees have been reported in the literature. Because a large percentage of these deal with juvenile cases, and since hereditary tendencies are more conspicuous in the younger group (20 percent),[20] the impression was created that juvenile glaucoma is the only hereditary form. In our series there were only five patients (or 10 percent of the hereditary cases) in whom the disease began at the age of 35 or less.

In the families which were studied, the heredity seems to be of a dominant type. The incidence of hereditary glaucoma is likely to be even higher than our statistics indicate. It may even be possible that some sporadic cases are either mutations or the result of recessive inheritance. Only extensive genetic investigations could adequately explore the

HEREDITARY GLAUCOMA

NUMBER OF CASES IN EACH FAMILY	NUMBER OF FAMILIES	TOTAL NUMBER OF CASES IN ALL FAMILIES
2	10	20
3	8	24
4	6	24
5	1	5
6	2	12
7	1	7
8	1	8
TOTAL OF HEREDITARY GROUP	29	100

Fig. 10 (Posner and Schlossman). The total known number of affected patients in 29 families is 100.

hereditary mechanisms in this disease, particularly with respect to the possibility of a recessive form. A more detailed review of the subject will be published elsewhere,[21] and further investigations are now in progress.

It is important to be aware of the hereditary potentiality of glaucoma because it frequently enables the physician to make an earlier diagnosis. Through a study of hereditary glaucoma, one can obtain a great deal of insight into the early and the mild forms of the disease. If careful pedigrees were routinely taken on all glaucoma patients, the pooling of this data would materially advance our knowledge of the disease.

Juvenile glaucoma

Juvenile glaucoma cannot be sharply separated from adult glaucoma. This is borne out by the fact that the upper limit of the age of onset has been variously placed at between 30 and 40 years by different authors. The clinical picture of juvenile glaucoma does not differ fundamentally from adult glaucoma. We use the age of 35 years as the upper limit, as was suggested by Loehlein.[20] In our series there are 23 cases of so-called "juvenile glaucoma." There undoubtedly were cases which were not included in this group, merely because the glaucoma was not discovered until after the age of 35 years. It is obviously illogical to regard juvenile glaucoma as a separate disease. According to Anderson[22] 87 percent of hydrophthalmos cases are recognized during the first year of life; while Loehlein's figures show that 78.9 percent of juvenile glaucoma begins between 15 and 30 years of age. Of our cases 78 percent had their onset between the ages 26 and 35 years. This is in line with the statistics of Haag[23] who finds a progressively increasing incidence with increase in age. Because of the wide gap between the peaks of incidence (according to age) in hydrophthalmos and juvenile glaucoma, it is improbable that more than a small fraction of juvenile cases are related to congenital glaucoma.

Myopia is said to be much more prevalent in juvenile than in adult glaucoma. In our series there were only 6 myopes out of 23 and only 2 of them had a myopia higher than −3.0 diopters.

Mild vs. Severe glaucoma

A review of the cases which were followed for many years reveals a wide variation in the severity of the disease. While some cases end in blindness within a few years, others remain in the mild stage for 20 years and longer. The majority of glaucoma cases fall somewhere between these extremes. It seems absurd to refer to a case of mild glaucoma, which has lasted 20 years, as "preglaucoma" (Gradle),[24] prodromal glaucoma, or early glaucoma. From the clinical point of view, it is important to be able to prognosticate the probable severity and course in a given case. The criterion for placing a case in the mild group is the lack of deterioration of the field of vision over a period of several years. We had 40 such cases in our series. A number of these would never have been discovered had it not been for the fact that other members of the family suffered from the disease.

One illustrative case is that of L. C., whose father and brother suffered from primary glaucoma. A tentative diagnosis of glaucoma was made 25 years ago. She has symptoms of recurring mild ocular pain and blurring of vision. The only clinical evidence obtained has been the occasional elevation of tension to between 30 mm. and 35 mm. Hg (Schiøtz) and a pupillographic curve similar to that found in primary glaucoma. Even homatropine did not raise the tension during a glaucoma-free interval, but the Knapp adrenalin test[25] was positive. Fields and central vision have remained normal.

This type of case may be looked upon as a true compensated glaucoma, since the rise

TABLE 1
EYE CONDITIONS ASSOCIATED WITH PRIMARY GLAUCOMA

Type	No. of Cases
1. Cataract	59
2. Corneal opacities	16
3. Diabetic retinopathy	7
4. Drusen in macular area	7
5. Retinal arteriosclerosis	6
6. Hypertensive retinopathy	5
7. Macular degeneration	5
8. Corneal dystrophy	4
9. Divergent strabismus	4
10. Trachoma	4
11. Thrombosis, central retinal vein	3
12. Retinal detachment	3
13. Uveitis	2
14. Ptosis	2
15. Exophthalmos	2
16. Vitreous opacities	1
17. Retinal changes secondary to myopia	1
18. Convergent strabismus	1
19. Occlusion, central retinal artery	1

of tension is not detrimental to the function of the eye; on the contrary, it may even help maintain its physiologic functions.

At the other extreme is a group of cases, generally of the chronic simple type, which do not respond to miotics, which show rapid deterioration of the fields and react unfavorably to any form of iris surgery. These are the malignant cases.* Fortunately, the incidence of this type of glaucoma is low. We had 11 such cases in our group. If such a case is suspected, it may be wise to resort to cyclodialysis, particularly if a filtering operation (involving trauma to the iris) has proved disastrous despite good surgical technique. As a general rule, if a case of glaucoma fails to respond satisfactorily to a mechanically well-executed filtering operation, it is advisable not to repeat the same type of surgery immediately. Whenever possible, it is better to wait, since the normalization of tension may be delayed as long as six months to a year. If the field continues to deteriorate, cyclodialysis should be the operation of choice.

* In the literature malignant glaucoma is usually referred to as synonymous with hemorrhagic glaucoma. We do not use this term in the same sense.

For the majority of the more typical glaucoma cases, Elliot's classification scheme[26] is of practical clinical value. He divides his cases into: (1) Early glaucoma, (2) established glaucoma, and (3) late glaucoma. Following a somewhat similar pattern, Kronfeld and McGarry[27] have divided their cases into four stages depending on the degree of field loss. They claim that this has prognostic value.

ASSOCIATED DISEASES

Tables 1 and 2 list the associated ocular and general diseases respectively. Among the former were 59 cases with cataract, 16 cases

TABLE 2
GENERAL DISEASES ASSOCIATED WITH PRIMARY GLAUCOMA

	Cases
1. Essential hypertension	64
2. Diabetes	31
3. Arthritis	26
4. Arteriosclerosis	15
5. Gall bladder disease	14
6. Allergy	11
7. Coronary disease	10
8. Obesity	8
9. Asthma	8
10. Deafness (nerve)	7
11. Hyperthyroidism	7
12. Psychoneuroses	7
13. Prostatitis	6
14. Lues	5
15. Sinusitis	3
16. Peptic ulcer	3
17. Migraine	3
18. Pernicious anemia	3
19. Hypothyroidism	2
20. Pyelitis	2
21. Bronchiectasis	2
22. Spondylitis	2
23. Paralysis agitans	2
24. Complete alopecia	2
25. Oxycephaly	1
26. Anosmia	1
27. Nasal polyps	1
28. Paget's disease	1
29. Myasthenia gravis	1
30. Colitis	1
31. Tuberculosis	1
32. Gonorrhea (inactive)	1
33. Pemphygus	1
34. Psoriasis	1
35. Gout	1
36. Meniere's syndrome	1
37. Amyotrophic lateral sclerosis	1
38. Buerger's disease	1
39. Spinal tumor	1
40. Otosclerosis	1

of corneal opacity, 7 cases of diabetic retinopathy, and 7 cases of drusen in the macula. It is difficult to know whether any causal relationship exists or whether these conditions are merely coincidental.

Among the general diseases associated with glaucoma, there were 64 cases of essential hypertension, 31 cases of diabetes, 25 cases of arteriosclerosis (including coronary disease), 14 cases of gall bladder disease, 8 cases of obesity, 11 cases of allergy, 8 cases of asthma, 7 cases of hyperthyroidism, and 3 cases of migraine. Clinical, as well as pupillographic evidence, points to a probable etiologic connection between glaucoma on one hand, and hypertension, diabetes, and obesity on the other. Elwyn[28] has pointed out that in glaucoma, like in hypertension and diabetes, there is a disturbance of the regulatory center of the autonomic nervous system, probably in the hypothalamus.

Seven cases of nerve deafness were observed in association with the simplex form. Some of them had a long history of intermittent tinnitus. One patient gave a family history of deafness. We are unable to state definitely the relationship between deafness and glaucoma, but there may be a disturbance of the pressure equilibrium in the inner ear analogous to that present in the eye.

Although definite psychoneurosis was present in only 7 cases, many more patients showed emotional instability of a less pronounced degree. This is in accord with a currently accepted notion, emphasized by Schoenberg,[29] that psychosomatic factors play an important role in the pathogenesis and course of glaucoma.

Glaucoma without hypertension

The occasional finding of optic atrophy with cupping and field changes has given rise to speculation as to the relationship of such cases to glaucoma on the one hand and to the optic atrophies on the other. Thiel[30] has introduced the term "pseudoglaucoma" for these cases. He believes that the majority of them are related to calcification of the internal carotid arteries. Knapp[31] has reported 10 cases of this type. Sjogren[32] in a recent discussion of this subject prefers to confine the use of the term pseudoglaucoma to those cases in which the optic atrophy and cupping can be definitely ascribed to pressure upon the optic nerve or chiasm. He believes that glaucoma without hypertension is a type of chronic simple glaucoma, because of the many transitional and atypical forms of glaucoma found in association with this condition. We subscribe to his view. In our group of chronic simple glaucoma, there were two patients who had typical field defects and cupping of the nerve without hypertension.

We have had under observation over periods of many years eight patients who show deep cupping similar in appearance to that found in glaucoma but without field changes or elevation of tension. Such cases could also be included under pseudoglaucoma. It is interesting to speculate that an optic atrophy superimposed upon a deep physiologic cupping may give a picture indistinguishable from glaucoma without hypertension.

Indeterminate group

The diagnosis of primary glaucoma should be limited to those cases in which the cause is not known. As soon as an adequate cause is discovered, it is mandatory to reclassify the case as secondary glaucoma. In recent years there has been a tendency, however, to speak of glaucoma as secondary, whenever a coexisting ocular condition is found, without being too critical about the causal relationship. For example, glaucoma which follows cataract extraction is, as a matter of course, regarded as secondary. Careful analysis and prolonged observation of these patients revealed that 8 out of 19 cases in the aphakic group might actually have been suffering from primary glaucoma. The cataract surgery may have had no relation

to the development of the glaucoma or it may have hastened the onset in a predisposed patient.

F. G., a 66-year-old woman with high myopia, had a cataract extraction in her left eye at the age of 58 years. This was followed by glaucoma with deep cupping and loss of the nasal field. Five years later, the tension in the right eye was found to be elevated to between 33 and 36 mm. Hg (Schiøtz). A diagnosis of asymptomatic glaucoma simplex of the right eye was made. A positive lability test[33] was obtained recently. The patient was observed for eight years.

A. S., a 75-year-old woman, developed asymptomatic glaucoma 18 months after a Ziegler discission on her right eye at the age of 64 years. The tension was consistently between 40 and 50 mm. Hg. Pallor and cupping of the disc with progressive loss of field ensued. The other eye remained normal. However, paredrine used as a provocative two years after the onset of the hypertension in the right eye, raised the tension of the left eye from 20 to 35 mm. Hg. This patient was followed for 16 years.

The fact that the glaucoma in these two cases was asymptomatic and that chronic simple glaucoma or a tendency to it was demonstrated in the unoperated eye, leads one to suspect that the aphakic eyes were probably predisposed to glaucoma even prior to surgery. Without a long follow-up, the true nature of the glaucoma in some of these cases would probably not have been uncovered. Before committing oneself to a diagnosis of secondary glaucoma in an aphakic eye, one should always do a provocative test, preferably a lability test or a water-drinking test,[34] on the unoperated eye.

There is a great deal of confusion regarding the relationship between glaucoma and iridocyclitis. According to the prevailing dogma, any case of glaucoma which shows the presence of cellular elements in the aqueous or on the posterior surface of the cornea, no matter how few in number, is relegated to the class of secondary glaucoma. Yet, no one can explain satisfactorily in what manner a few cells in the aqueous or a few keratic precipitates can produce ocular hypertension in the absence of a plasmoid aqueous.

We reported nine patients who showed recurrent unilateral attacks of glaucoma with mild cyclitic signs.[35] These may be regarded as a clinical entity and they probably form an intermediate group which shows characteristics of both primary and secondary glaucoma. We have proposed the name of "recurrent glaucomato-cyclitic crises" for this syndrome.

There were two cases which showed iridocyclitis as a complicating incident in the course of primary glaucoma. On the other hand, there were 18 cases of chronic uveitis in which true secondary glaucoma supervened. Glaucoma with uveitis may be classified in the following manner:

1. Iridocyclitis, either precipitating an acute attack of primary glaucoma or incidental to the course of primary glaucoma.
2. The syndrome of recurrent glaucomato-cyclitic crises.
3. Iridocyclitis producing true secondary glaucoma as a result of changes in the filtration channels or by the osmotic effect of a plasmoid aqueous.
4. Late secondary glaucoma as the sequel to organic alterations produced by iridocyclitis, like iris bombé.*

Two cases of mild bilateral glaucoma were associated with nevus flammeus. In one case the nevus occupied the right arm and right half of the trunk but spared the face. There were some aneurysmal dilatations over the right disc. The other case showed a nevus flammeus of the face on the right side. Pupillography in both instances showed cen-

* We do not wish to imply that even in this condition the mechanical factors (anterior and posterior synechias) are alone responsible for the ocular hypertension. Weiss, in *Kurzes Handbuch für Ophthalmologie,* Vol. II, p. 67, makes note of the fact that there are cases of iris bombé which are not accompanied by glaucoma.

tral sympathetic disturbances, but not of the type found in primary glaucoma. The water-drinking test was positive in each case, the right eyes showing greater elevation of tension. Both patients responded well to 1-percent pilocarpine.

Usually the glaucoma associated with nevus flammeus is infantile or juvenile and limited to the affected side. Ehrlich[36] reports one case of bilateral glaucoma with unilateral nevus flammeus and refers to the only other similar case in the literature. The glaucoma in both of these cases was of a severe degree and of the juvenile type. In our two cases the glaucoma was bilateral and unusually mild. Even if vascular dilatations, as is generally assumed, were present in the uvea on the affected side, it is difficult to see how this could account for the bilateral mild glaucoma which was present in these cases. For this reason, we thought it best to set them apart from the general group of secondaries.

One patient had attacks of glaucoma associated with marked edema of the lids and conjunctiva since the age of 38 years. She also suffered from allergies, asthma, and hyperinsulinism. Attacks often occurred after menstruation. It is possible that this is a case of chronic congestive glaucoma with manifestations suggestive of allergy. We have classified this patient, for the present, as allergic glaucoma.

One patient, A. L., a man with myopia of −20D. developed retinal detachment of the right eye at the age of 18 years. This was followed seven years later by an asymptomatic glaucoma in the same eye. The tension of the left eye was normal at this time; but five years later, at the age of 32 years, it became elevated. The fundus shows no chorioretinal degeneration. Cyclodialysis has normalized the tension in the left eye for the past 1½ years. In this patient the glaucoma in the right eye might have been regarded as secondary to retinal detachment. However, the subsequent development of asymptomatic glaucoma of the simplex type in the other eye casts doubt on the original diagnosis.

Two cases of glaucoma were associated with retinitis pigmentosa. W. F., a 52-year-old man, has retinitis pigmentosa which was discovered in 1936 at the age of 41 years. Following a head injury, in 1940, he began to see hálos around lights. The tension was moderately elevated in both eyes, but responded temporarily to pilocarpine. Two weeks after medication was instituted, an acute attack occurred in the right eye. Bilateral iridencleisis normalized the tension. The fields are those characteristic of retinitis pigmentosa. The second patient, N. F., a 38-year-old white woman, with retinitis pigmentosa, developed bilateral glaucoma of the chronic congestive type. Two of her sisters have retinitis pigmentosa, but only one of them has developed glaucoma. One brother and one sister are normal.

The association of retinitis pigmentosa and glaucoma was first noted by Galezowski in 1862.[37] Since then, numerous cases have been cited in the literature. Schmidhauser (cited by Leber[38]) found the incidence of glaucoma in retinitis pigmentosa to be 2.78 percent, while the incidence of glaucoma in all patients of the Tuebingen Clinic was 0.73 percent. Leber interprets this difference in incidence to mean that the association of the two diseases is not purely coincidental. Von Hippel[39] suggests as the cause for the glaucoma, an obstruction of the drainage channels by pigment. Blessig[40] reports a sibship of nine members of whom two sisters had chronic simple glaucoma alone, while two brothers and one sister suffered from pigmentary degeneration without ocular hypertension. The glaucoma associated with retinitis pigmentosa may be either of the congestive or the chronic simple variety. It behaves no differently from primary glaucoma. The data on this condition is insufficient for reliable statistical studies and the paucity of the anatomic material makes it difficult to determine the causal relationship between the two diseases.

The indeterminate group (fig. 11) was introduced here primarily because of the difficulty of classifying certain cases of glaucoma as either primary or secondary, even after prolonged and careful study. The

INDETERMINATE GROUP

TYPE	NO. OF CASES
GLAUCOMATO-CYCLITIC CRISES	9
PROBABLY PRIMARY GLAUCOMA IN APHAKIA	8
NAEVUS FLAMMEUS WITH MILD GLAUCOMA	2
ALLERGIC GLAUCOMA	1
GLAUCOMA WITH RETINAL DETACHMENT	1
GLAUCOMA WITH RETINITIS PIGMENTOSA	2

Fig. 11 (Posner and Schlossman). Even after prolonged and careful study, it is difficult to classify certain cases of glaucoma as either primary or secondary.

eight cases associated with aphakia, as well as the cases with allergic glaucoma and with retinal detachment, are probably primary glaucoma. The nine cases of recurrent glaucomato-cyclitic crises are probably an entity. They may be considered intermediate between primary and secondary glaucoma. The glaucoma associated with nevus flammeus is probably secondary. The cases with retinitis pigmentosa are difficult to classify. Even Thiel[41] admits that their pathogenesis is obscure.

Secondary glaucoma

The 76 cases of secondary glaucoma are listed in Table 3. The most common cause was uveitis. Cataract extraction, including discissions, accounted for 11 cases. This number does not include the eight patients mentioned in the indeterminate group. There were nine cases of buphthalmos and one case of microphthalmos. Of the former, eight were males and only one was a female.

Two cases associated with detachment of the anterior layers of the iris are included. Schoenberg, in 1927, reported the first case in a man aged 51.[42] The second case is a 46-year-old man with high myopia, microcornea, and congenital lues. Detachment of the anterior layers of both irides was first noted at the age of 34 years. Four years later, he saw rainbows and the tension was found to be elevated. Subluxation of the left lens was present.

Vogt[43] notes the association between detachment of the anterior mesodermal layer of the iris, spontaneous subluxation of the lens, and glaucoma. He considers this condition to be due to senile degeneration of the mesodermal structures. However, both of our cases occurred in patients under 55 years of age. The glaucoma in these cases may be the result of analogous degenerative changes in the pectinate ligament.

As is evident from Table 3, secondary glaucoma is a heterogeneous group which is characterized by the association of ocular hypertension with some other ocular disease or abnormality. We need not necessarily assume a direct causal relationship between the two conditions in every instance. Very often the exact mechanism involved in the

TABLE 3

Secondary Glaucoma

	Cases
1. Uveitis	19
2. Cataract extraction	11
3. Buphthalmos	9
4. Hemorrhagic glaucoma	3
5. Tumor	3
6. Rubeosis iridis diabetica	3
7. Detachment of anterior layers of iris	2
8. Detachment of retina	2
9. Chorioretinitis	2
10. Swollen lens	2
11. Interstitial keratitis (luetic)	2
12. Glaucoma capsulare	2
13. Microphthalmos and congenital cataract	1
14. Subluxation of lens	1
15. Subluxation of lens (Marfan's syndrome)	1
16. Perforating injury of cornea	1
17. Needling of congenital cataracts and congenital lues	1
18. Nonmagnetic foreign body	1
19. Recurrent corneal ulcers	1
20. Traumatic cataract	1
21. Needling of congenital cataracts	1
22. Rupture of eyeball	1
23. Retinal degeneration in high myopia	1
24. Unknown etiology	6

production of hypertension is not known. Duke-Elder,[44] in his definition of secondary glaucoma, is careful not to imply a cause and effect relationship. The difficulty of deciding, in a given case, whether the glaucoma is primary or secondary is borne out by the fact that patients with primary glaucoma are no less subject to other ocular diseases than nonglaucomatous individuals (see fig. 4). Three cases of primary glaucoma developed thrombosis of the central retinal vein some time after the diagnosis of glaucoma had been made. Moreover, patients with other ocular diseases may, in the course of time, develop glaucoma.[45]

Comments

This study is an attempt to consider the glaucoma problem from a purely clinical point of view. The latest developments in research along experimental and physicochemical lines will be dealt with at a future time. The statistical and analytic study of our material reveals certain features which will be briefly reiterated in order to clarify a few more or less fundamental concepts.

When one compares an isolated case of acute congestive glaucoma which is cured by surgery with a case of asymptomatic chronic simple glaucoma in which the tension is within normal limits or only slightly elevated, one has the impression that here are two separate diseases. Analysis of a large number of cases, however, invariably reveals gradations in the symptomatology and course to such an extent, that one is unable to draw a sharp line of demarcation at any point in the series. Furthermore, there is a mixed group of cases in which one may find either a congestive glaucoma in one eye and chronic simple in the other or a chronic simple glaucoma with acute exacerbations in one or both eyes. One is forced to accept the inevitable conclusion that, in the present state of our knowledge, primary glaucoma should be regarded as a single clinical entity. It is possible that further investigations will reveal primary glaucoma to be more than one disease; but the criteria for such a classification will not be the same as those generally used at present. We have utilized the conventional nomenclature because it is useful from a clinical point of view, and because it does not carry any etiologic implications.

Further evidence for assuming a unitary concept of primary glaucoma is found in a study of hereditary cases. In the same family tree, one may find examples of congestive and chronic simple glaucoma. Pupillography,[46] which is a means of studying the state of the central autonomic nervous system through the pupillary response, shows the same type of curve in congestive and chronic simple glaucoma.

On the other hand, there are some points of difference between the two forms of glaucoma which may be used as arguments for regarding them as separate entities. The prevalence of females over males is greater in congestive than in chronic simple glaucoma. Also, there are more hyperopes and monocular cases in the former than in the latter. The shallow anterior chambers and narrow angles predominate in the congestive forms.

Glaucoma should be regarded as a constitutional disease in the sense of a dysfunction of the central regulatory mechanism[28] of the autonomic nervous system similar to the group of metabolic disorders such as diabetes, hypertension, and obesity. It is possible that this dysfunction constitutes the primary, or at least the predisposing cause, while the various anatomic and physicochemical conditions of the eye are modifying or precipitating factors.

The fact that congestive glaucoma occurs in a small percentage of eyes with narrow angles and may occur also in eyes with wide angles tends to indicate that the angle plays a secondary role in the etiology of the disease. It should be remembered that the width of the angle and the depth of the

anterior chamber are intimately related to the architecture of the remainder of the eye, such as the shape of the ciliary body, the mode of attachment of the iris root, and the position of the anterior surface of the lens. Thus, while eyes with narrow angles are more prone to develop the congestive form of glaucoma, the causal relationship between the angle and glaucoma has not been established. In fact, Busacca[47] has questioned the entire concept by pointing out that the angle is not a static structure but that its width varies from time to time.

It is common experience to find that the tension varies with different individuals within wide limits, but that it is fairly constant for each individual. Generally, both eyes have the same tension. This corroborates the hypothesis of a central regulatory mechanism for the intraocular pressure. A significant difference of tension between the two eyes is more important as presumptive evidence of glaucoma than an elevation of tension which is equal in both eyes. Downey[48] has recently emphasized this diagnostic point. At least four of our patients had a continuously elevated tension above 35 mm. Hg without showing any deterioration of field or ophthalmoscopic changes for from two to three years. It appears that in some cases, pathologically increased tension does not produce any interference with function. It may be assumed that intraocular pressure is kept at a definite level which is optimal for the maintenance of the normal function of that eye. The level varies with each individual. We do not know why these variations are present; nor do we know what constitutes the upper limit of normal for any given eye. Consequently, the assumption that a tension above 30 mm. Hg is abnormal need not hold for all cases. There are normal individuals whose tension is around 30 mm.; yet these patients show negative responses to provocative tests and never develop glaucoma. In the early stages of glaucoma, the ocular hypertension may be a necessary compensatory mechanism, serving a useful purpose in that it helps to maintain normal metabolic conditions in the eye. For example, sclerosis of the choriocapillaris or impaired permeability of the lamina vitrea may interfere with the nutrition of the neuroepithelium. It was shown by Evans[49] and Berens and Posner[50] that there is a circulation of intraocular fluid from the vitreous into the retina and optic nerve. Increase in intraocular pressure would tend to favor the flow of fluid into the retina and thus supplement the nutrition of the retina.

As long as this mechanism is adequate to maintain the normal function of the retina and the field does not deteriorate, one may regard the glaucoma as being in a compensated phase. As soon as field loss sets in, the limits of compensation have been exceeded. It may be interesting to speculate, in the light of this hypothesis, why the central area and the temporal periphery of the visual field are the last to be destroyed. The increase in intraocular pressure, while helping to maintain the function of the neuroepithelium, exerts a deleterious effect on the retinal circulation. Consequently, the relatively avascular areas of the retina (macula and nasal periphery) survive longer than the more vascular zones. This relationship is more fully discussed elsewhere.[51]

The following case is suggestive of the role which ocular hypertension may play in maintaining the normal metabolism of the lens. Since 1942, H. F., a 57-year-old chemist, has had an almost continuous right ocular hypertension, usually above 40 mm. Hg (Schiøtz). Up to the present, his visual acuity has remained 20/15 and his fields have shown no changes other than downward enlargement of the right blindspot. The tension of his left eye has consistently remained around 22 mm. Hg. Recently, he developed a posterior cortical cataract in his left eye, while his right lens has remained normal. The general impression that surgical intervention in a glaucomatous eye (with the subsequent reduction of tension) often hastens the development of a cataract, may

have a basis in an interdependence between the ocular tension and the metabolism of the lens.

The concept that a diseased process is an expression of an imperfect or inadequate attempt at compensation for another disturbance is in line with the principles of general pathology which have been excellently formulated by Aschoff.[52]

Earlier in the paper it was shown that the characteristics of congestive glaucoma as clinically observed may be better interpreted by assuming the existence of a threshold of vasomotor irritability which determines the ease with which a congestive attack becomes manifest. This may vary with different patients and at different times. It is not known why the threshold is more easily exceeded in some cases than in others, but a few clues are suggestive. In congestive glaucoma the ratio of male to female eyes was 1:26 while in asymptomatic chronic simple glaucoma, it was 1:1. Women, especially in the menopause, show greater vasomotor instability than men. The relationship of congestive glaucoma to vasomotor phenomena is further demonstrated by the prevalence of congestive attacks in association with allergy. Nine out of 11 patients with allergy had congestive glaucoma; 2 had chronic simple glaucoma.

We have considered the increase in tension as a compensatory mechanism which is controlled by the central autonomic nervous system. The nature of the primary affection in the eye is not known. It may be related to senile or nutritional changes. There is ample evidence that disturbances other than ocular hypertension play a role in the causation of the clinical picture of glaucoma. In the first place, the height of the tension bears no definite relationship to the severity of the field loss. Secondly, many patients who have been normalized by surgery or miotics, continue to have progressive deterioration of the visual field. While the aforementioned considerations are indicative of the presence of a factor other than hypertension, additional evidence may be adduced from a consideration of cases of glaucoma without hypertension. Magitot[53] divides this group into three categories:

1. Myopic glaucoma with low tension.
2. Mild intermittent unilateral glaucoma.
3. Field changes and excavation of the disc either with or without calcification of the internal carotids.

Sjogren[32] does not draw a sharp line between glaucoma with and without hypertension, but rather stresses the numerous transitional forms which are frequently observed. He believes that the basis of glaucoma lies in a circulatory disturbance independent of the intraocular pressure which constitutes only one symptom of the disease. Although our series includes only two cases of glaucoma without hypertension, there are others in whom the elevation of tension was never marked and who, nevertheless, showed extensive field loss. This is particularly true of the cases of chronic glaucoma associated with high myopia.

We feel that, although the tension undoubtedly plays an important role in glaucoma, there may be other factors which contribute to the causation of the disease. The following possibilities are suggested.

1. Disturbance of central autonomic nervous system (may include psychosomatic factors).
2. Vasomotor instability.
3. Hereditary factors.
4. Arteriosclerosis (a) General, and (b) Local.[54]
5. Blood pressure.[55]
6. Metabolic disturbances: diabetes, obesity, endocrine.
7. Relation of intracranial to intraocular pressure.[56]
8. Degenerative changes in the nervous tissue. (a) Lacunary degeneration in the brain and nerve;[32] and (b) Schnabel's cavernous atrophy.
9. *Local factors:*

a. Anatomic (Schlemm's Canal, chamber

angle, retinal circulation, choroid, and so forth).

b. Nutritional.

c. Congenital.

d. Physicochemical:

(1) Increased capillary permeability.

(2) Diminution in cholinergic substance.[16]

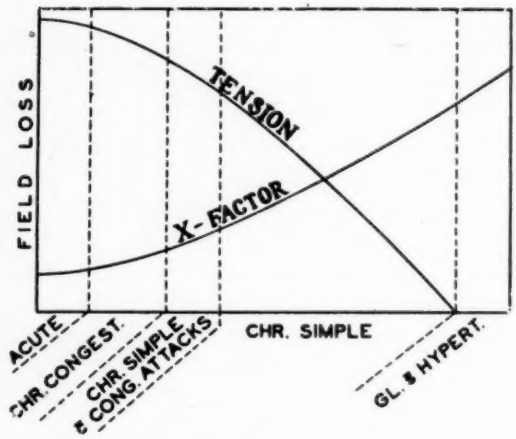

Fig. 12 (Posner and Schlossman). SCHEMATIC REPRESENTATION OF THE ROLES PLAYED BY OCULAR HYPERTENSION AND THE X-FACTOR* IN THE PRODUCTION OF FIELD LOSS IN PRIMARY GLAUCOMA. Glaucoma is shown as a single disease with varying clinical pictures. A representative sample of cases forms a continuous series in which the field loss appears to be dependent upon the aforementioned variables. In acute glaucoma, the duration and height of the ocular hypertension play the predominant role. In chronic congestive and chronic simple glaucoma with congestive attacks, the X-factor plays a more important role. In chronic simple glaucoma, the field change is dependent partly on the X-factor and partly on the hypertension. In this group there are cases with relatively low degrees of hypertension in which the progressive field loss suggests that the X-factor plays a predominant role. This group merges into glaucoma without hypertension where the X-factor is obviously the chief cause of the field loss.

* Sum total of all other disturbances.

In Figure 12 we have attempted to visualize graphically how the field changes may be regarded as a function of the tension and the sum total of the other factors, which we call the "X-factor" for the sake of simplicity. In acute congestive glaucoma, the tension factor plays the predominant role and the field changes appear to depend directly on the height and duration of the hypertension. In glaucoma without hypertension, on the other hand, the X-factor is chiefly responsible for the loss of field. The vast majority of the cases fall somewhere between these two extremes. In chronic simple glaucoma without symptoms, the visual field changes show less relation to the tension than in the chronic congestive form, while the mixed group which contains elements of both may be placed between chronic congestive and chronic simple glaucoma.

The hypotheses expressed in this paper represent the conclusions drawn from the material available for our study. They are offered with the hope of stimulating further investigations along these and other lines of thought.

SUMMARY

The present study is a correlation of 474 cases of glaucoma from private practice, of which 373 are primary; 158 patients have been followed for five years or longer.

In this series there are 71 eyes with acute congestive, 140 eyes with chronic congestive, and 422 eyes with chronic simple glaucoma. Twenty-four additional eyes showed chronic simple glaucoma with congestive attacks (Schmidt-Rimpler). In the congestive form the ratio of male to female eyes was 1 : 2.6. In glaucoma simplex there was only a slight preponderance of females over males, while in asymptomatic glaucoma simplex, the ratio was 1:1. The incidence of monocular cases was three times as great in the congestive types as in chronic simple.

In 60 percent of the cases of primary glaucoma, the onset was between 41 and 60 years of age. Considering refractive errors between +0.5D. and −0.5D as emmetropia, there were 141 emmetropic, 283 hyperopic, and 114 myopic eyes. The ratio of hyperopes to myopes is similar to that found in the general population.

Fifty cases showed hereditary tendencies. The pedigrees studied exhibited dominant

inheritance. In 23 patients, the onset was below 35 years of age. These juvenile cases differed in no way from the rest of the group. Forty patients followed a very mild course and many of them would have remained unrecognized were it not for the attention paid to heredity.

Besides the cases of primary glaucoma, there were 25 which could not be definitely classified as either primary or secondary. Of this group, nine had the syndrome of recurrent glaucomato-cyclitic crises (recurrent attacks of unilateral glaucoma with mild cyclitic signs). Eight patients with aphakia had glaucoma which probably was primary. Bilateral mild glaucoma with unilateral nevus flammeus was present in two cases and two patients had retinitis pigmentosa associated with glaucoma.

In the light of present knowledge, primary glaucoma is regarded as a single disease in which the primary or predisposing cause consists of a dysfunction of the central regulatory mechanism, while the various anatomic and physicochemical conditions of the eye are modifying and precipitating factors.

A case of mild glaucoma without field loss is considered to be in a compensated phase, in the sense that the hypertension may serve a useful purpose. The prevalence of monocular cases in the congestive group, and the action of miotics in modifying the congestive attacks, may be explained by assuming the existence of a threshold of vasomotor irritability which must be exceeded before a congestive crisis manifests itself. In addition to ocular hypertension, there are other factors which influence the course of glaucoma. In the various forms of glaucoma, the tension and the other factors (X-factor) play a varying role in determining the progress of the field changes.

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SOME PROBLEMS IN THE CALIBRATION OF TONOMETERS*

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The present study was undertaken at the request of the Committee on Standardization of Tonometers of the American Academy of Ophthalmology and Otolaryngology and has been supported by a special grant from the Academy. Laboratory space for the work was provided by the Wilmer Institute and some of the human eyes used in the calibration measurements were supplied by the Eye Bank Associates, Inc. The present report concerns some of the preliminary aspects of the work and an attempted analysis of the factors that must be taken into consideration in such calibrating measurements.

The reasons for undertaking this work were many. In the first place, the magnificent study of Schiøtz in this field has never been comprehensively checked by any other investigator and, as will appear in the analysis below, Schiøtz's study is open to certain possible criticisms, the significance of which could be evaluated only by fresh experimental data.

In the second place, the Committee on Standardization of Tonometers has adopted certain specifications for the construction and dimensions of the Schiøtz tonometer. These specifications were based on a careful analysis of Schiøtz's own description of his instrument. It was found necessary, however, to specify some characteristics in respect to which Schiøtz's description is ambiguous. Choice in respect to such specifications has been guided by actual measurements on instruments certified by Schiøtz himself, but since some variation in the instruments was found there remained slight uncertainty as to how closely these modern specifications duplicated the instrument which Schiøtz used as a reference standard and which he used in his calibration experiments. Some of Schiøtz's calibrating measurements lend themselves readily to accurate reproduction and by this means the present standard instrument could be compared with that of Schiøtz.

In the third place the calibration experiments of McLean have led to a somewhat different estimate of the average normal intraocular pressure than had been reached by Schiøtz. The resulting disagreement between the Schiøtz and McLean scales has been a constant source of confusion. The present undertaking afforded an opportunity to test simultaneously a reference-standard Schiøtz, McLean, and also Gradle tonometer on the same set of eyes. While all sources of systematic error may not have been excluded in these measurements, it is to be expected that calibration scales based on these measurements would yield concordant clinical readings on the same eye with the three different instruments. For these measurements, a reference-standard Schiøtz instrument was contributed by the Sklar Company. This instrument was specially machined to correspond as closely as possible to the specifications of the Committee on Standardization of Tonometers. A similar reference-standard McLean tonometer, measured and adjusted by Dr. McLean, was contributed by Dr. McLean, and a reference-standard Gradle tonometer was contributed by the American Optical Company. Parallel measurements were made with all three instruments. The present report, however, concerns only those made with the Schiøtz.

I. OPEN MANOMETER READINGS

It will be recalled that in his calibrating experiments Schiøtz attached eyes to a manometer by a cannula inserted through the

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optic nerve (fig. 1). Introducing any desired pressure into the eye, he then rested the tonometer on the cornea and recorded the tonometer scale reading. Two sets of readings were made. In one set which he called the "open manometer" readings, the stopcock between the cannula and the manometer was

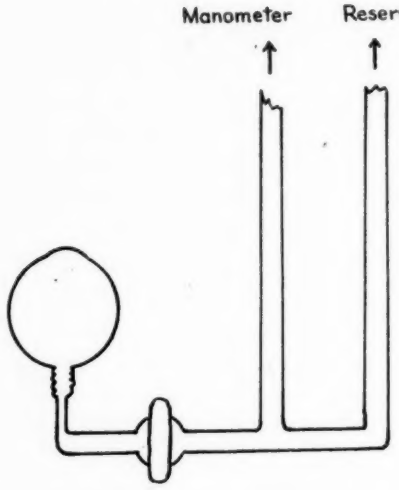

Fig. 1 (Friedenwald). Diagram of apparatus used by Schiøtz in calibrating his tonometer.

left open. These readings served to correlate the scale reading with the intraocular pressure in the eye while it carried the weight of the tonometer. In the second set of readings, which Schiøtz called "closed manometer" readings, a desired pressure was introduced into the eye, the stopcock then closed, and the tonometer applied. The closed manometer readings were the ones actually used for calibration purposes but the open manometer readings were useful to Schiøtz as a preliminary guide.

The open manometer readings showed, according to Schiøtz, much less experimental scatter from eye to eye than did the closed manometer readings, and this is indeed to be expected since variations in ocular rigidity would have much less effect on the former than on the latter readings. A repetition of the Schiøtz open manometer measurements could, therefore, afford a very good check in respect to whether the present reference-standard instrument does in fact closely resemble the original Schiøtz in certain important characteristics. Open manometer readings were, therefore, made on pig, cat, rabbit, and human eyes. Ten to 20 eyes of each species were used. Corneal curvatures were measured with a keratometer on all except the pig eyes, and cat and rabbit eyes were chosen whose corneal curvatures closely approximated the average normal human corneal curvature of 7.8- to 7.9-mm. radius.

In order to compare these various sets of data with each other and with the original observations of Schiøtz, some empyrical formula needs to be fitted to the data. The following argument was followed in arriving at such a formula. When the tonometer plunger comes to rest at a given scale reading, the downward force of the weight of the

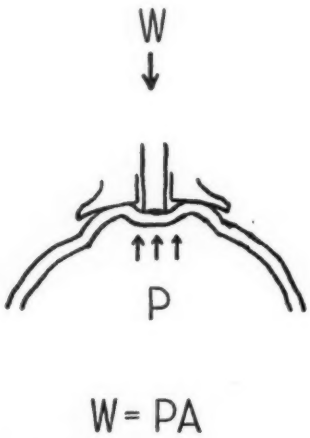

Fig. 2 (Friedenwald). Forces supporting the tonometer when it rests on the cornea.

plunger must be balanced by an upward force of the intraocular pressure acting over the area of indentation (fig. 2). This equality of the upward and downward forces can be expressed by the equation formulated by Fick and Maklakow:

$$W = PA$$

provided the weight W, pressure P, and area A are given in appropriate units. Thus if the

weight is given in grams, the area in square centimeters, the pressure must be expressed in grams per square centimeters. Now, if it should turn out that for a given tonometer scale reading, that is for a given depth of indentation, the area was constant then, by plotting our data with W/P as ordinate and scale readings as abscissa, all of the data for a given species of animal should fall on the same curve. The results of such a plot of the data obtained on cats, pigs, and human eyes is shown in Figure 3 in which Schiøtz's original data on human eyes are also shown. Each point plotted represents the average scale reading obtained on 7 to 20 different eyes with a given plunger load and intraocular pressure. It will be seen that the data do in fact fall on straight lines with no significant variation in respect to plunger weight. It follows that, for a given scale reading, the area of indentation is the same irrespective of whether this indentation is produced by a small plunger load at a low intraocular pressure or by a larger plunger load at a higher intraocular pressure. A straight line may be fitted to these data according to the formula

$$\frac{W}{P} = a + bR.$$

By the method of least squares, the values for a and b can be determined. For instance in the data on the cats' eyes a = 0.0795, b = 0.0091.

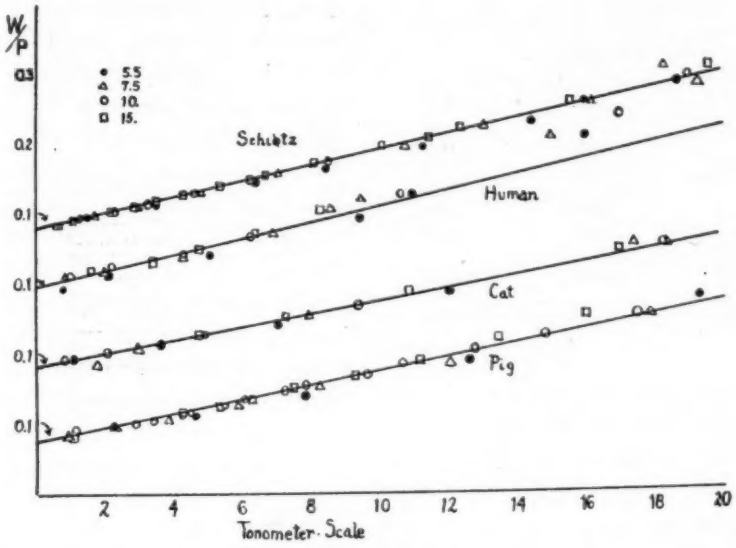

Fig. 3 (Friedenwald). Plot of open manometer data on human, pig, and cat eyes compared with Schiøtz original data on human eyes. The ordinate scale for each successive set of readings is shifted by 0.1 unit.

Applying the same analysis to the data obtained on the different species tested, and also to the data of Schiøtz's original measurements on human eyes,[1] one obtains a set of closely similar values for the coefficients a and b as shown in Table 1. The deviations between these different calculated values of the coefficients are probably statistically significant, but it is to be doubted whether they represent biologically significant differences. Thus, while there are differences between the values obtained on the four species, the values obtained from Schiøtz's data are identical with those I have obtained on the pig and differ slightly from those that I have

obtained on human eyes. Moreover, taking eyes with the same corneal curvature—cat, rabbit, and human—the corneal thickness is greatest in the cat, least in the rabbit. The coefficients, however, do not lie in any reasonable relationship to corneal thickness. In the calculations later in this paper I have used the coefficients derived from the measurements on cats' eyes, because these lie near to the average values for the whole series, and because the technician who made these particular measurements did so with unusual care and reliability.

TABLE 1

ANALYSIS OF DATA ACCORDING TO THE FORMULA W/P=a+bR

	a	b
Human	.085	.012
Human (Schiøtz)	.075	.0105
Pig	.075	.0105
Cat	.0795	.0091
Rabbit	.080	.0086
Average	.079	.0101
Value Chosen	.0795	.0091

In view of the close agreement between Schiøtz's open manometer data and those which I have obtained on these four species, it may be concluded that in respect to those aspects of tonometer construction which are involved in this type of reading, the present reference-standard instrument is a good reproduction of Schiøtz's original instrument.

The close agreement of the open manometer readings in the four different species requires some further comment. It is to be remembered that the pig's cornea is about 2-mm. thick, the rabbit's only about ½ mm., while the cat and human corneas fall between these extremes. Moreover, while the cat and rabbit eyes were chosen to have corneal curvatures closely approaching the average human, the radius of curvature of the pig's cornea is approximately 12 mm. If there were an appreciable resistance of the cornea to indentation one would expect an appreciable difference in the readings made on thick as against thin corneas. The fact that no difference was found which could be related to corneal thickness indicates that corneal resistance to indentation is negligibly small.*

One other aspect of these measurements should be noted. From the analysis above it is seen that the ordinates in these curves represent the area of the plunger indentation. Now, when the plunger is just flush with the foot plate, that is, for zero indentation, it must be supported by an area of cornea equal precisely to the area of cross section of the plunger. This area can readily be calculated and amounts to 0.0707 cm.^{2} One can inquire at what tonometer scale reading does the ordinate have this expected value.

As seen in Figure 4 which represents an enlargement of the type of curve plotted in Figure 3, the scale reading for zero indentation is not at zero on the tonometer scale but at minus one. The explanation of this apparent anomaly is quite simple. The radius of curvature of the tonometer foot plate and of the foot of the plunger are both 16 mm. When the instrument is put upon a test block of 16-mm. radius, the scale reading is minus one. Schiøtz, however, thought that the plunger would sink slightly into the corneal epithelium, deforming the epithelium before an actual indentation of the corneal stroma would take place. He estimated the depth of this epithelial deformation as 1/20 mm., or one tonometer-scale unit, and moved the zero of his tonometer scale one unit to the right to allow for this presumed effect. The results of the measurements with the open manometer show that this shifting of the zero

* The foot plate of the Schiøtz tonometer having a radius of curvature of 16 mm. is considerably flatter than even the pig's cornea. Similar measurements with the Gradle and McLean instruments, with their much more concave foot plates, yielded marked discrepancies between the open manometer readings on pigs as compared with the other species, but these tonometers also gave close agreement of open manometer readings on cats, rabbits, and humans.

by Schiøtz was not justified. I am not suggesting that the scale should be shifted back, since its present location has the merit of a familiar convention, but the erroneous location of the zero has bearing on some theoretical analyses of tonometric readings.

II. Closed manometer readings

The technique used by Schiøtz in his closed manometer readings has been briefly described. The eye is supported by being fastened on a cannula inserted through the optic nerve and the tonometer indents and distorts the cornea much as it does in ordinary clinical measurements, but since the full weight of the tonometer as well as that of the eye itself is supported by the cannula an additional indentation and distortion at the posterior pole results (fig. 5). The stresses placed upon the eye under these circumstances are very different from those imposed by the tonometer in vivo when the eye is supported by the orbital cushion. Schiøtz was himself aware of this discrepancy in his calibrating readings and attempted to avoid this in a later series of measurements in which eyes were studied postmortem without enucleation by inserting a fine cannula into the anterior chamber at the limbus. He found, however, that it was almost impossible not to distort the cornea by such a limbal cannula and that this method led to a very wide scatter in the experimental readings.

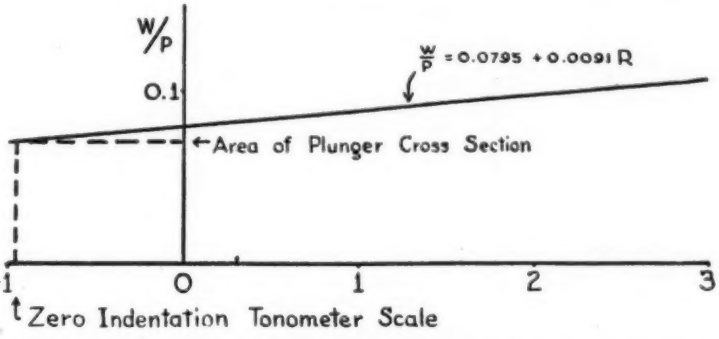

Fig. 4 (Friedenwald). Plot of open manometer data showing location of scale reading for zero plunger indentation.

In order to eliminate these difficulties and to support the test eye in a manner similar to that which occurs in the living patient, a somewhat more complicated apparatus has been developed (fig. 6). As in Schiøtz's original measurements, the eye is attached to a cannula inserted through the optic nerve, but this cannula is connected with a manometer through a universal joint and does not support the eyeball. A membrane is tied onto the cannula and arranged in such a fashion as to form a closed chamber, an artificial orbit, supporting the eyeball. This closed chamber is filled with fluid not con-

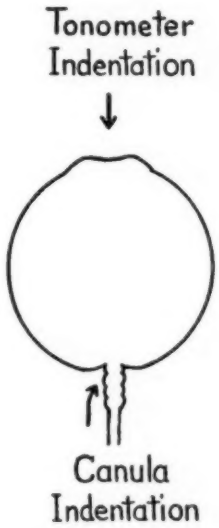

Fig. 5 (Friedenwald). Distortion of eyeball in Schiøtz's closed manometer readings.

nected with the manometric system, and the eyeball floats on this fluid chamber. When the tonometer rests on the eye, the globe is depressed slightly, the membrane stretches, and the pressure in the artificial orbit rises. pressure of 40 cm. of water more than one cubic millimeter of fluid leaked out per minute. Among the 30 human eyes which were obtained for this study, only four were found satisfactory by these very rigid requirements. The results of the closed manometer readings on these four eyes are given in Table 2.

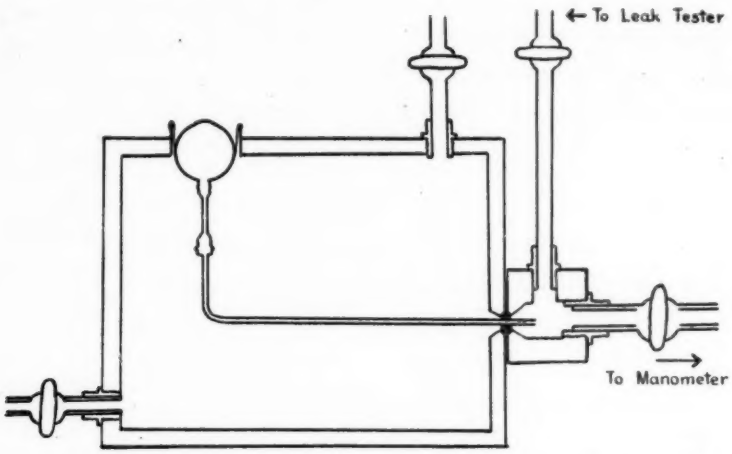

Fig. 6 (Friedenwald). Apparatus for closed manometer readings in which the eye is supported on an artificial orbit and indentation of the posterior pole by the cannula is avoided.

Only eyes that were quite fresh and free from disease or deformity were used for these measurements. After the cannula has been attached, it is necessary to aspirate some of the vitreous in order to insure a free flow of fluid in and out of the eye through the cannula. Only those eyes were used for closed manometer measurements in which a free connection was established with minimal manipulation. Finally, after the eye was attached in the calibrating apparatus it was tested for leaks and was rejected if at a

The measurements on these four eyes do not, of course, suffice for calibration of the Schiøtz tonometer. They do, however, suffice to show that this method of calibration is unreliable. The first inkling that this was so was obtained by comparing the scale readings obtained with two different plunger loads at the same intraocular pressure. For instance at 30-cm. water pressure the av-

TABLE 2

RESULTS OF CLOSED MANOMETER READINGS ON FOUR HUMAN EYES PASSING RIGID REQUIREMENTS

Plunger Weight	5.5			7.5			10			12		
Pressure cms. H_2O	15	30	45	15	30	55	15	30	60	20	50	75
Human Eye												
1	11	6	0	12	7	2.25	15	10	4.5	14	7	4
2	8	4.75	0	9.5	5	1.0	10.5	8	3	11	5.75	3
3	8	5	3	11	7	2.0	13	9	3	12	5	2
4	7.5	3	0	8.75	5.5	2.0	11.5	8.75	4	13	7	4
Average Scale Reading	8.63	4.69	0.75	10.31	6.13	1.81	12.50	8.94	3.63	12.5	6.20	3.25
Log P mm. Hg	1.0465	1.3475	1.5236	1.0465	1.3475	1.6107	1.0465	1.3475	1.6485	1.1714	1.5693	1.7454
Log P_t mm. Hg	1.4121	1.5238	1.6746	1.5065	1.6143	1.7632	1.5842	1.6640	1.8192	1.6634	1.8163	1.9118
Δ Log P	.3656	.1763	.1510	.4600	.2668	.1425	.5377	.3165	.1707	.4920	.2470	.1663
V	21.10	12.56	6.24	20.61	12.02	5.70	21.55	14.13	6.21	20.51	8.91	5.29
Rigidity Coefficient Δ Log P/V	.0173	.0140	.0242	.0223	.0222	.0250	.0249	.0224	.0275	.0240	.0277	.0314

erage reading with the 5.5 weight was 4.7, while at the same pressure the average reading with the 10 weight was 8.9. Comparing these readings with similar pairs of readings that I had obtained some years ago on 500 normal human eyes,[2] it became evident that the rigidity of these dead eyes differed somewhat from that in the living. It was not apparent from these measurements whether the rigidity was the same throughout the set of measurements or whether it changed progressively. If the former were true, then correction factors might be calculated and an adequate calibration scale obtained provided a sufficient number of eyes were tested. If the latter were true, then the effort at direct calibration would have to be abandoned and some indirect procedure substituted. In order to find out what ocular rigidity corresponded to each one of these readings, it was necessary to get additional data as to the volume of fluid displaced by the tonometer foot plate and plunger when they were resting on the cornea.

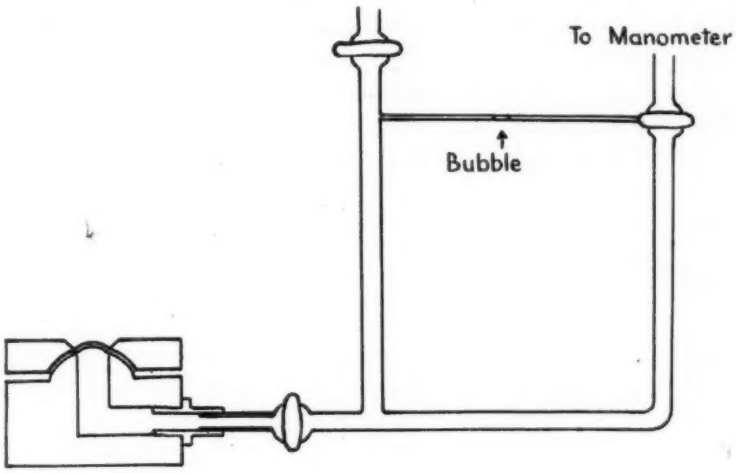

Fig. 7 (Friedenwald). Apparatus for measuring the volume of fluid displaced when the tonometer rests on the cornea.

III. Volume of indentation

To obtain the necessary data a new set of chambers was designed into which the anterior segment of an eye could be clamped leaving the cornea exposed (fig. 7). The chamber was connected with a manometer and reservoir through a calibrated capillary tube into which a bubble was introduced. With the pressure set at a desired level, the tonometer was lowered on to the cornea and the movement of the bubble recorded. Measurements were made on cat, rabbit, and human eyes at various pressures and with each of four different plunger loads.

Before analyzing the results of these measurements, the question of their reliability needed to be answered. It appeared possible that although the tissues were clamped into place with great care, the cornea might nevertheless be pulled or distorted in such a way as to make the readings unreliable. As a check against this possibility, we recorded the tonometer scale reading at each measurement and compared these, pressure for pressure, with our previous open manometer readings on whole eyes. The result showed that the open manometer readings were not distorted by this new method of attaching the eye to the manometer.

Each set of readings with a given plunger load on a set of eyes of the same species was found to fit quite satisfactorily an empyrical formula of the type:

$$P^N V = K$$

or the equivalent

$$\text{Log } P = B - \frac{1}{N} \text{ Log } V.$$

The numerical coefficients of these equations, N and K for the first, or N and B for the second, varied with the plunger load.

$$B = \frac{1}{N} \text{ Log } K.$$

Comparing eyes of the same species with different corneal curvatures, it was found that for a given pressure and plunger load the volume of the displaced fluid was greater the more deeply curved the cornea. This was to have been anticipated as may be seen from Figure 8, since, if the area of contact is the same in each case, more fluid will be displaced the higher the corneal dome.

Comparing eyes of the same corneal curvature but of different corneal thickness, for instance cats versus rabbits, it was found that the greater the corneal thickness the greater the volume of fluid displaced. This might also have been anticipated as may be seen from Figure 9 since, if the area on the inner surface in which the intraocular pressure supports the tonometer is the same in each case, more fluid will be displaced when the inner surface of the cornea is more deeply curved.

Comparing human eyes with those of rabbits and cats, it was found that the data on the human eyes agreed quite closely with those obtained on rabbits of the same corneal curvatures. Consequently the coefficients for the empyrical equations expressing the relation of pressure to volume of fluid displaced were first calculated from the rabbit data and then adjusted slightly to fit the human data. The combined results of these experiments and those with the open manometer correlate the tonometer scale reading with the intraocular pressure of an eye carrying the tonometer and the volume of the displaced fluid.

Fig. 8 (Friedenwald). Schematic illustration of the relation between corneal curvature and volume of fluid displaced. In each diagram the area of contact between tonometer foot plate and cornea is the same, but the cornea on the right is more deeply curved than that on the left.

Fig. 9 (Friedenwald). Schematic illustration of the relation between corneal thickness and volume of fluid displaced. In each diagram the curvature of the anterior corneal surface is the same and the area of the indentation of the posterior corneal surface is the same, but the cornea on the right is thicker, its posterior surface more deeply curved, and the volume of displaced fluid consequently greater.

These direct measurements of the volume of the displaced fluid may be compared with the indirect estimate which I made of the same volume in a study reported a number of years ago.[2] It is found that the volume actually measured is somewhat greater than that previously estimated. The reasons for this discrepancy are embedded in the various approximations used in the earlier calculations. No account was taken in those calculations of the fact that the curvature of the inner surface of the cornea differs from that of the outer surface. Furthermore the volume of the plunger indentation and of the foot-plate indentation were calculated inde-

pendently although the former influences the latter. Comparing the volumes of displaced fluid at the same intraocular pressure for two different plunger loads, there is quite good agreement between the two estimates, indicating that the earlier calculation of the volume of indentation produced by the plunger were reasonably accurate and that most of the errors in the earlier estimate concern the volume displaced by the tonometer foot plate.

With these new data we can now return to the closed manometer measurements on the four eyes reported above. For each reading we know the initial intraocular pressure. From the tonometer scale reading and the open manometer data we can calculate the pressure in the eye with the tonometer resting upon it. From this pressure and the known plunger load we can, with the aid of the new data, calculate the volume of fluid displaced. Knowing the initial and final pressure and the volume displaced one can, as has been shown elsewhere,[2] calculate the coefficient of rigidity. These calculations are shown in Table 2. It will be seen that, far from being constant during the experiment, the coefficient of rigidity of these eyes rose as the intraocular pressure was increased and as the experiment proceeded. It is evident that these dead eyes do not recover, as do living eyes, from the effects of transitory stresses. There is no reason even to believe that the ocular rigidity which characterized the very first reading in the series corresponded to that normally present in vivo. It is to be concluded, therefore, that the direct manometric calibration of tonometers on dead eyes is impossible and that errors due to abnormal rigidity are present not only in the closed manometer readings which I have just reported but also in the similar readings used by Schiøtz in his original calibrating measurements.

IV. Discussion

The situation, however, is by no means hopeless. The open manometer measurements and the measurements of the volume of displaced fluid are both unequivocally free from errors due to variations in ocular rigidity. From these data one can calculate calibration curves for any assigned value of ocular rigidity. Moreover, by finding out what are the most frequently paired readings obtained with different plunger weights on normal human eyes in vivo one can calculate the average normal ocular rigidity. Data on which such a calculation can be based are found in the report of paired readings with two plunger weights on each of 500 normal human eyes which I have previously reported.[2] I have calculated the average normal ocular rigidity from these clinical data using the current more reliable experimental data for open manometer pressures and volume of displaced fluid.

The calculations involved in the procedure are long and laborious and have not yet been completed, and I am not as yet prepared to present new calibration curves. I wish to confine the present report to the problems encountered in calibration experiments rather than to the final conclusions. Nevertheless, certain trends are already clearly visible in those parts of the calculations that have so far been completed. It seems clear that the calibration scales of Schiøtz and also of McLean are both too high and that the average normal intraocular pressure is probably between 18 and 19 mm. Hg rather than between 22 and 24 mm. Hg, as thought by Schiøtz or 27 to 28 mm. Hg, as thought by McLean.[3]

The best estimate that I am able to make for the coefficient of ocular rigidity of the average normal living eye has the value 0.0245 corresponding to an increase of 5.8 percent in the intraocular pressure for a displacement of one cubic millimeter of fluid. If one compares this average normal ocular rigidity with the values found on dead eyes in Table 2, it is seen that these eyes start out more flaccid than normal and become progressively more rigid during the course of the experiment passing through the normal range and finally reaching supranormal values. It should be noted that in these experi-

ments excessively high pressures were avoided. The highest pressure used was 75 cm. H_2O, that is, 55 mm. Hg. The cause of the abnormally low rigidity in dead eyes is not clear. One might have expected that with the loss of the compressible vascular bed, the enucleated eye would have a higher rather than a lower rigidity than in vivo.

If eyes with abnormally low rigidity are used for calibration measurements, then the scale determined by these experiments will give too high a pressure reading for eyes of normal rigidity. Conversely, if eyes with abnormally high rigidity are used for calibration, then the scale determined by these measurements will give too low a pressure reading for eyes of normal rigidity. Since the enucleated eyes used in closed manometer experiments start out with abnormally low rigidities and end up with abnormally high rigidities, a scale determined from such measurements will deviate from the true value in both directions. It is natural in such measurements to start with low pressures and proceed to higher ones. It would appear that this was the procedure used by Schiøtz and that in the region of normal pressures determined with the 5.5 weight his scale gives too high a pressure value, while at the upper limit with the heavier weights the scale is too low. McLean, on the other hand, who had only one plunger weight to deal with, and who was most meticulous in avoiding high intraocular pressures until the end of his experiments, appears to have done most of his measurements on eyes that were still in the abnormally flaccid state. His scale appears, therefore, to err throughout on the high side, though percentually the deviation decreases in the upper ranges.

It is perhaps of interest to note that Verhoeff on the basis of his experience with the Souter tonometer has for years maintained that the average normal intraocular pressure is not above 20 mm. Hg. The Souter tonometer, although afflicted with very large and erratic reading errors, is, at least theoretically, an instrument in which variations in ocular rigidity do not significantly affect the reading.

It should be pointed out that tonometric calibration based on the indirect method which I have outlined involves the use of a theory as to the role of ocular rigidity in the tonometric reading for which there is both a priori and experimental support, but which is, nevertheless, assuredly subject to further refinement and correction. In view of this, the calibrations that can be achieved by this method, although having a high probability of correctness, cannot be regarded as final even within the limits of error of the experimental data used for the calibration.

Finally, lest there be any misunderstanding, it must be clear that, no matter what the calibration scale in terms of millimeters of mercury, a tonometer scale reading under 3 with the 5.5 weight still means an abnormally high pressure or rigidity.

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BETA IRRADIATION AS A POSSIBLE THERAPEUTIC AGENT IN GLAUCOMA*

An experimental study with the report of a clinical case

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Whatever the special etiologic factors may be in a given case of glaucoma, the condition is always the result of an increase in intraocular pressure. The increased tension is itself the result of (1) the production of an abnormal amount of intraocular fluid, or (2) decreased absorption of a normal amount of fluid, or (3) blockage of normal intraocular channels of drainage.

Medical and surgical therapeutic methods, none of which have given uniformly satisfactory results, have up to this time been chiefly aimed at increasing the rate of flow through drainage channels. Recently cyclodiathermy[1] has been employed, with the objective of decreasing the production of intraocular fluid by destruction of the secretory process of the ciliary body. The theory is sound, but the method is attended with too much risk to warrant its routine use. It may cause damage to the lens, the cornea, the iris, the retina, or the sclera. Loss of vitreous, hemorrhage into the anterior chamber, and scleral slough are always possibilities, and all may be associated with irreparable impairment of vision.

It occurred to us that the effect aimed at by the use of diathermy in glaucoma, that is, destruction of a portion of the ciliary body, with a resulting decrease in the production of aqueous and, in turn, a decrease in intraocular pressure, might be brought about without injury of the lens or other ocular structures by the use of irradiation. The considerable experimental work done up to this time on the effects of beta irradiation on the eye, as well as the clinical use of the method, has apparently been limited to the lids, the cornea, and the conjunctiva.[2-4] In Warren's[5] excellent review of the effects of irradiation on the tissues no mention is made of irradiation of the ciliary body, nor has an independent search of the literature revealed any such studies. The experiments reported herewith were therefore undertaken, for the purpose of determining (1) the effect of irradiation with beta rays on the ciliary body and (2) the degree of destruction which could be brought about in that structure without injury to the lens.

Materials and Methods

The materials used in this study consisted of 18 adult rabbits, each weighing 5 pounds or more. Two animals (nos. 3B and 12) died of intercurrent disease early in the experiment, and another (no. 3), which developed cataract and exophthalmos 5 days after the first treatment, was discarded, since these are not the usual results of irradiation.

Treatment consisted of the application of 50 mg. of radium, in an applicator devised by Iliff, over the ciliary body of the left eye for 30-minute periods. One group of animals received one treatment. Three other groups received, respectively, 2, 3, and 4 treatments, at 7-day intervals. All applications were made under anesthesia obtained by subcutaneous injections of nembutal. The rabbit was placed on the table, with the head to the side, and the applicator was so suspended that it was in direct contact with the eyeball. Its weight kept the eyelids open without difficulty, and the position of the eye was such that the rays passed into the ciliary body through the sclera.

Three animals (nos. 7, 14, and 16), which

* From the Departments of Ophthalmology and Pathology of the School of Medicine of Louisiana State University and the Charity Hospital of Louisiana. Presented as an exhibit at the Southern Medical Association meeting in November, 1947.

had had, respectively, 3 treatments, 2 treatments and 1 treatment, each, were preserved for further study. No gross changes have been observed in their eyes to the date of writing (20 weeks). The remaining 12 animals were killed at intervals of from 5 to 42 days after the first treatment. Paraffin sections of the eyes were made in 3 cases (nos. 5, 10, and 11), but the decision to employ this method proved unfortunate, since it did not permit satisfactory preparation of the lens. In the other 9 animals the eyes were prepared by the celloidin technique and were stained with hematoxylin and eosin. In each instance the untreated right eye was used as a control.

Results

Gross Findings

All the animals which received 2, 3, and 4 treatments developed severe mucopurulent conjunctivitis with necrosis of both the palpebral and the bulbar conjunctiva, obviously as the result of failure to protect these tissues from the rays. The results were what might have been expected and probably could be obviated by proper screening.

There were no gross changes and no ophthalmoscopic abnormalities in the iris or the lens in any case. The control eye was negative in every animal.

Fig. 1 (Haik, Breffeilh, and Barber). Section of left-eye ciliary body of rabbit No. 15, which received one application of 50 mg. of radium for 30 minutes and was killed 21 days later. The ciliary processes show edema, and there are slight endothelial changes in the walls of the capillaries.

Microscopic Findings

Group I. The 4 animals in the group (nos. 10, 11, 17, and 15) each received one treatment consisting of the application of 50 mg. of radium for 30 minutes. They were killed at 5 (no. 10), 9 (nos. 11 and 17) and 21 (no. 15) days after the first treatment. A 5th animal (no. 16) which was given the same treatment was preserved for further observation. The lens was lost in 2 animals (nos. 11, 10) as the result of preparation by paraffin section.

In animal No. 11, which was killed at 9 days, the ciliary body was swollen and showed marked infiltration of both acute and chronic inflammatory cells, with some necrosis. Degeneration of the ciliary epithelium and dispersion of pigment were also noted. The reaction in this eye was comparable to that observed after 3 treatments (50 mg. of radium for 90 minutes) and 4 treatments (50 mg. of radium for 120 minutes).

Animal No. 17, which was also killed 9 days after treatment, and animal No. 15, which was killed 21 days after treatment, both showed only slight edema of the ciliary processes and some scattering of pigment (fig. 1). The endothelial cells in the walls of the capillaries were clumped and swollen. The nuclei of the fibers of the lens were slightly scattered from the normal equatorial bow in both animals, and the fibers appeared hydropic.

Group II. The 5 rabbits in this group (nos. 5, 8, and 13) received 2 treatments

each at 7-day intervals (a total of 50 mg. of radium for 60 minutes). They were killed, respectively, 12, 15, and 28 days after the first treatment (5, 9, and 21 days after the last treatment). All the specimens presented the usual features of inflammation. The stroma of the ciliary body (fig. 2) was edematous, with early hyalinization. The epithelium was vacuolated and clumps of pigment could be seen in the stroma. Capillaries in the ciliary processes showed evidence of stasis. A few blood vessels in the stroma had thickened walls and the endothelium was irregular. There was no evidence of healing.

Fig. 2 (Haik, Breffeilh, and Barber). Section of left-eye ciliary body of rabbit No. 8, which received two applications of 50 mg. of radium at 7-day intervals for a total of 60 minutes and was killed 16 days after the first treatment. The ciliary processes show stasis, and there is early hyalinization of the stroma.

The sclera was somewhat less cellular than normal in all 3 rabbits but otherwise showed no changes. The lens in animal No. 5, which was prepared by paraffin section, was lost. The lenses in the other rabbits (nos. 8 and 13) were definitely damaged (fig. 3). The nuclei of the fibers were disarranged and the fibers were swollen and in some areas were liquefied. Cataractous changes were observed in both of these eyes.

Fig. 3 (Haik, Breffeilh, and Barber). Section of ciliary body of left eye of rabbit No. 4, which received four applications of 50 mg. of radium at 7-day intervals for a total of 120 minutes and was killed 16 days after the first treatment. The stroma of the ciliary body is smooth and hyalinized, and the epithelium is replaced by a layer of flat cells.

Group III. The 3 rabbits in this group (nos. 7, 9, and 6) received three treatments each at 7-day intervals (a total of 50 mg. of radium for 90 minutes). Rabbit No. 7 was kept for further study. Rabbits No. 9 and No. 6 were killed, respectively, 23 and 35 days after the first treatment (9 and 21 days after the last treatment). The inflammatory changes in both these specimens appeared more chronic than the changes observed in the animals in Group II, and in both there was slight evidence of healing. There was

Fig. 4 (Haik, Breffeilh, and Barber). Section showing ciliary body of normal control.

marked hyalinization of the stroma of the ciliary body and the blood vessels were seen only in faint outline. There was hemorrhage into the ciliary processes.

Changes in the lens (fig. 4) were more marked in these specimens than in the specimens in Group II. Vacuolation of fibers and fragmentation of nuclei in the treated eyes of both animals were observed, and cataracts were present in both.

Group IV. The 3 rabbits in this group (nos. 2, 1, and 4) each received four treatments at 7-day intervals (a total of 50 mg. of radium for 120 minutes). They were killed, respectively, 26, 30, and 42 days after the first treatment (5, 9, and 21 days after the last treatment). The changes observed in the treated eyes of rabbits No. 2 and No. 1 were similar to those described for the specimens in Group III, that is, obliteration of blood vessels, slight healing of the ciliary body, and cataracts. Rabbit No. 4, however, which was killed 21 days after the fourth treatment and 42 days after the first treatment, showed entirely different findings (fig. 5). There was considerable advance in the reparative process. The ciliary epithelium was completely absent over the area treated and was replaced by a thin, flat membrane. No blood vessels could be identified, and the stroma was smooth and hyalinized.

The lens (fig. 6) was cataractous, with necrotic nuclei and vacuolated, hydropic fibers. The sclera in the treated area appeared less cellular than in the untreated eye, and only a few scattered leukocytes could be seen. Early organization was apparent in the subconjunctival tissues. The

Fig. 5 (Haik, Breffeilh, and Barber). Section of lens of left eye of rabbit No. 8. The lens shows early cataractous changes in the fibers at the equator.

fact that this animal was an albino rabbit accounts for the lack of pigment in the specimen.

Control Specimens. None of the untreated right eyes used as controls showed any microscopic changes (figs. 4 and 8).

Discussion

The experiments reported in this communication were planned in the light of the changes in the vascular endothelium, leading to proliferation and various degrees of occlusion of the lumen, which have been reported after beta radiation and which are most marked in the endothelium.[2-4] The object of the study was to determine whether it was possible, by the use of such radiation, to reduce the aqueous production in the rabbit's eye by bringing about obliteration or partial occlusion of the capillaries in a portion of the ciliary body. An excessive dosage was deliberately used, to permit a study of the type and rate of the healing process.

Fig. 6 (Haik, Breffeilh, and Barber). Section of lens of left eye of rabbit No. 9, which received three applications of 50 mg. of radium at 7-day intervals for a total of 90 minutes and was killed 23 days after the first treatment. The lens shows scattered nuclei and swollen fibers in the equatorial region.

Fig. 7 (Haik, Breffeilh, and Barber). Section of lens of left eye of rabbit No. 4. The lens is cataractous, with necrotic nuclei and vacuolated, hydropic fibers.

In one animal (no. 11) the application of 50 mg. of radium for 30 minutes resulted in excessive destruction of the ciliary body. In 2 other rabbits (nos. 17 and 15) which had the same amount of treatment, there was only slight damage to the endothelium of the ciliary blood vessels. In the animals treated by two applications of 50 mg. of radium for 30 minutes per treatment definite obliteration of the vessels of the ciliary body resulted. When four treatments were given (50 mg. of radium for a total of 120 minutes), healing, as evidenced by hyalinization

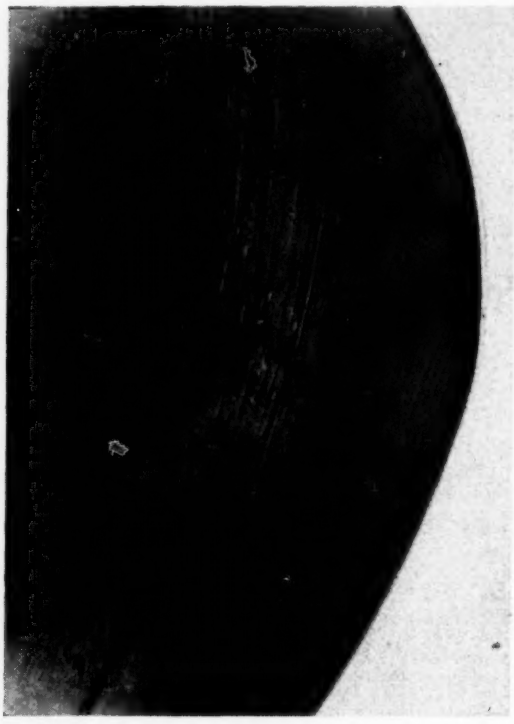

Fig. 8 (Haik, Breffeilh, and Barber). Section showing lens of normal control.

of the ciliary stroma, was observed 21 days after the first treatment and was quite complete at 42 days. The cumulative effect of the dosage of radium did not seem to alter the histologic details to any great degree.

In planning these experiments, the observations of previous workers on other tissues were used as a starting point. According to Linser (cited by Warren[6]), maximum effects of irradiation are observed in the blood vessels by the 8th posttreatment day and the process of repair is well advanced by the 20th day. In our own experiments, although the reaction in the eye after irradiation is less marked than the reaction in other parts of the body, the peak of vascular dilatation was reached on the 9th day and healing was evident by the 3rd week after the last treatment, which are comparable intervals. Edema and inflammation of the palpebral and bulbar conjunctiva reached a maximum at about 10 to 12 days and healing was evident by the 3rd week after the last treatment.

The significant time interval, however, seems to be related to the number of days after the first treatment rather than after the last. Animals No. 13 and No. 4 were both killed 21 days after the last treatment. The ciliary body and the lens showed an equal degree of damage in both specimens, but the degree of healing differed. In animal No. 4, which was killed 42 days after the first treatment, there was definite evidence of healing, but in animal No. 13, which was killed 28 days after the first treatment, there was no evidence at all of healing. The reparative process therefore seems to require more than 28 posttreatment days, and the cumulative effects of radium seem to have little influence on the results.

Rabbits No. 11 and No. 17, both of which were killed 9 days after the first (only) treatment, showed no changes in the lens, and animal No. 15, killed 21 days after the first (only) treatment, showed only a slight change. All the other rabbits, regardless of the amount of treatment which they had received or the time at which they were killed, showed definite cataractous changes. To make this method practical, therefore, it will be necessary to establish the minimum dose of radium which will secure the desired vascular obliterative changes in the ciliary body without, at the same time, damaging the lens. It will also be necessary to develop an applicator which will permit the emanation of pure beta rays while at the same time excluding gamma rays, which are damaging to the lens. At the present time no such applicator exists.

Case report

In the following case the application of radium was a last resort. The method was resorted to because it was impossible to accomplish with it any more harm than had already been accomplished by the disease process.

A 4-year-old boy with congenital bilateral buphthalmos was first seen in the Charity Hospital of Louisiana Eye Clinic November 14, 1946. An iridotasis was performed on the left eye on November 18th and on the right eye on November 25th. Massive prolapse of the ciliary body occurred into the operative wound on the right side, the cornea became hazy, and there was marked injection of the ciliary body. Enucleation was therefore carried out on December 16. The specimen showed hydrophthalmos, dislocation of the lens, and detachment of the retina and choroid as the result of hemorrhage, chronic uveitis, and glaucomatous cup. Carcholin therapy was instituted, and the child was followed in the clinic until the end of May, 1947.

When he was next seen, in August, 1947, the tension in the remaining (left) eye was 55 mm. Hg (Schiøtz). It varied between 30 mm. and 49 mm. until October 2nd. On this date, 50 mg. of radium was applied to the nasal side of the limbus and 50 mg. to the temporal side, each application lasting 10 minutes; the Iliff applicator was used. A similar application was made on October 6th. The day after the second application the tension (Schiøtz) was 25 mm. Hg. On October 11th, it was 35 mm.; October 12th, 19 mm.; October 13th, 24 mm.; October 14th, 30 mm.; October 17th, 35 mm.; October 19th, 40 mm.; and October 21st, 40 mm. On October 21st, 50 mg. of radium was applied for 10 minutes at the 9-o'clock position. Between that time and the present writing (December 9, 1947) the tension has varied between 25 and 55 mm. It was above 40 mm. on only 7 of the 29 readings. It was consistently higher for a week after miotics were discontinued (November 20th), then showed a somewhat lower trend, although readings were still between 30 and 40 mm.

Vision at the time of the first application of radium had decreased to 3 to 4 feet. There has been no additional loss to date.

Whether irradiation will accomplish anything in this case it is impossible to say. To date, however, there have been no evidences of harmful effects, the only reaction following irradiation being a slight, transitory reddening of the eyelids. The most encouraging feature of the case is that since the application of radium there has been no progression of a condition which was progressing before treatment was instituted and the natural tendency of which is toward progression. A long period of observation will be necessary before definite statements can be made concerning results, and at the present time there would be no justification for using this method in any case which was not as clearly hopeless as this one was.

Summary and Conclusions

A series of experiments has been described, in which beta irradiation was applied to the ciliary body of rabbits in varying amounts over varying periods of time, in an endeavor to determine the practicability of treating glaucoma by obliteration of the vascular supply of the ciliary body, with the objective of bringing about a decrease in the production of intraocular fluid.

While vascular changes were achieved in the majority of cases, damage to the lens also resulted in almost every instance in which the desired changes were achieved.

The method proposed thus seems theoretically sound. To make it practical, however, a dosage of radium must be established which will achieve the desired changes in the ciliary body without at the same time damaging the lens. This objective could probably be accomplished if an applicator were available which would permit the emanation of beta rays but would screen out gamma rays.

A clinical case is presented in which irradiation was employed because the state of the eye was already practically hopeless. The treatment has apparently produced no ill effects but the therapeutic results are still inconclusive.

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FLARE-UP OF TRACHOMATOUS PANNUS DUE TO ARIBOFLAVINOSIS*

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Pannus is an essential manifestation of trachoma. Appearing at a very early stage of the disease it is decisive in the differential diagnosis. It represents the progress by continuity of the disease from the conjunctival lesion into the subepithelial tissue of the bulbar conjunctiva and the cornea. In one

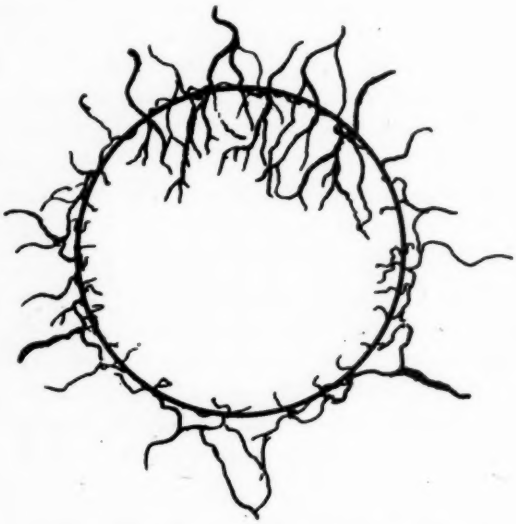

Fig. 1 (Landau and Stern). Trachomatous pannus and ariboflavinosis.

form or another it remains recognizable throughout the whole life of the patient.

Treatment of pannus in active trachoma coincides with the treatment of the palpebral conjunctiva. Once the conjunctival lesions enter the cicatrizing stage, the vessels of the pannus become thinner, anemic, and eventually almost invisible unless the slitlamp is used.

There are cases, however, in which a marked discrepancy exists between the aspect of the cornea and the palpebral conjunctiva. The latter may be entirely smooth and well cicatrized, and yet a marked pannus, that is, hyperemic blood vessels, may extend over the cornea. The patients complain of watering, itching, and burning, and sometimes exhibit even marked photophobia. This condition often proves very difficult to treat. Operations like peritomy and peritectomy suggested for such cases have been abandoned because their results are decidedly unsatisfactory.

When some cases of this kind were examined carefully with the slitlamp, it was found that the cornea was vascularized not only in its upper half, as in classical trachomatous pannus. The typical aspect of grayish infiltration in the corneal epithelium was present only in the upper part but fine blood vessels of 1 to 3 mm. in length could be seen encroaching upon the clear cornea from the limbus over the entire circumference, similar to the limbal "flush" described in ariboflavinosis (fig. 1). This peculiar finding induced us to attempt to influence the con-

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dition with riboflavin and other components of the vitamin-B complex in a number of cases.

Ten cases have been observed so far, and the history of a typical one follows. The relevant data of the other cases are presented in Table 1.

Report of a case

Case 6. J. K., a woman, aged 45 years, suffered during childhood from trachoma which had healed with corneal opacities. In the right eye vision was reduced to counting of fingers at 1 m. For the past few weeks she complained of photophobia and burning in both eyes. The corneas presented an acute trachomatous pannus and, in addition, a typical ariboflavinotic corneal vascularization. The pannus reached the pupillary region in the left eye, and visual acuity amounted to 6/36. The patient received 5 mg. of riboflavin twice daily by mouth. One week later, considerable improvement was noted. Vision in the left eye was 6/18 and the corneal vessels became much thinner. After another week of treatment, the subjective symptoms vanished, the corneal vessels were greatly constricted, and the pannus assumed the aspect usual in inactive trachoma. With a vision of almost 6/12 the patient declared that she had not felt so well for a long time.

TABLE 1

DATA ON 10 CASES OF TRACHOMATOUS PANNUS TREATED WITH RIBOFLAVIN

No.	Sex	Age	Trachoma Stage	Trachom. Pannus	Ariboflavinotic			Diet	Treatment	Time (days)	Result	Visual Acuity
					Corneal Vascularization	Cheilitis	Glossitis					
1	f	19	IV	+++	++++	—	—	good	Riboflavin 2×5 mg. daily	7	very good	
2	f	42	IV	+++	+++	+	+	very poor	Riboflavin 2×5 mg. Bevitex 1.5 g. Yeast 3 g.	14 14 14	very good	
3	f	18	IV	++	+	—	—	poor	Riboflavin 2×5 mg. daily	18	very good	
4	f	44	IV	+	+++	—	—	very poor	Riboflavin 2×5 mg. daily	7	very good	
5	f	42	IV	++++	++++	—	+	very poor	Riboflavin 2×5 mg. daily	7	very good	
6	f	45	IV	++	+++	—	—	poor	Riboflavin 2×5 mg. daily	9	very good	O.S., 6/60 *improved to* O.S., 6/12
7	f	14	IV	+++ O.D. ++ O.S.	+	—	+	poor	Riboflavin 2×5 mg. daily	4	very good	O.D., 6/24 *improved to* O.D., 6/18
8	m	62	IV	Total	Pannus	++	++	very poor	Betotal 2 cc. i.m. daily	6	good	
9	m	58	IV	Total	Pannus	++	++	very poor	Betotal 2 cc. i.m. daily	6	good	
10	f	22	IV	+++	++	—	—	good	Betotal 2 cc. i.m. daily	4	very good	

None of the patients received any kind of local treatment.
"Betotal" ampules (2 cc.) contain 3.0 mg. Vitamin B_1, 1.5 mg. B_2, 20 mg. nicotinic acid, 2.0 mg. B_6, 3.0 mg. calcium pantothenate and 400 mg. crude liver extract.
"Bevitex" tablets contain 3.3 mg. B_1, 2.0 mg. B_2, 20 mg. nicotinic acid, 0.4 mg. B_6, 3.0 mg. pantothenic acid.

Comment

All cases responded very well to medication with riboflavin alone or with vitamin-B complex in the form of yeast or proprietary preparations. The total B complex has lately been given preference because ariboflavinosis must be regarded as an expression of a relative deficiency in the other constituents of the B complex, as well. The normal dietary sources of riboflavin (meat, bread, dairy products) contain considerable amounts of thiamine, nicotinic acid, and so forth, and

it is correct to assume that an insufficient intake of riboflavin also entails a diminished intake of the other members of the group. The complex deficiency may remain subclinical with the exception of the riboflavin deficiency, because the eye seems to be a particularly sensitive indicator of a disturbance in cell metabolism. The corneal tissue, devoid of blood vessels, can be assumed to suffer first when the absence of riboflavin prevents the proper synthesis of the respiratory enzymes. It was, therefore, decided also to administer B-complex preparations, after the first cases that had received riboflavin alone had shown the prompt response described above.

To explain the therapeutic success with vitamin-B complex in such "intractable" pannus in cases of completely cicatrized trachoma, it must be remembered that the blood vessels constituting the pannus do not leave the cornea entirely once the trachoma has become inactive. Although contracted, they still exist and remain visible, with the slit-lamp, as minute channels with a sluggish, much reduced circulation. If a riboflavin deficiency occurs at this stage of trachoma, the well-known response of the cornea sets in—the limbic plexus becomes flushed and fine capillaries encroach upon the cornea, most probably in order to relieve the disturbance of the respiratory process of the corneal cells. In trachoma IV, where the disease has ceased to be active but where the vessels of the pannus are still present, the limbic vessels in this region do not seek new pathways to invade the cornea, having at their disposal the old channels of the trachomatous pannus. The vessels become engorged and present the picture of an active trachomatous pannus—with this difference that, in addition, newly formed vessels have invaded the cornea in the rest of its circumference, hitherto devoid of vessels.

Adequate provision of riboflavin will then, of course, exert its beneficial effect on the newly formed vessels as well as on the old pannus. The ocular signs of ariboflavinosis are relatively frequent among the patients of our out-patient department who come from the poorer classes and whose diet is frequently grossly deficient.

An additional factor may play a rôle in the flare-up of a pannus in clinically cured trachoma. The corneal tissue of an eye which has undergone trachoma is rarely entirely normal and may be subject to occasional breakdowns as shown by the frequent recurrences of corneal infiltrations in some cases of inactive trachoma. An analysis by Feigenbaum* in 1921, of 3,389 cases of Koch-Weeks conjunctivitis of which about one third were also affected with trachoma, may be quoted in order to illustrate this fact. The frequency of involvement of the superficial corneal layers was 3.1 percent in patients free from trachoma, and 13.1 percent in trachomatous patients, which, according to the author, clearly points to a less favorable state of the corneal tissue in trachoma. It is conceivable that the corneal tissue of such eyes is more sensitive to a lack of riboflavin.†

* Feigenbaum, A.: Hornhautkomplikationen bei der in Palästina epidemisch vorkommenden Koch-Weeks Conjunctivitis. Klin. Monatsbl. f. Augenh., 67 :436-443, 1921.

† We are indebted to the Winthrop Products, Inc., New York, and Teva, Ltd., Jerusalem, who kindly furnished the riboflavin (Ribotone and Betotal, respectively,) used in these trials.

MIKULICZ'S DISEASE AND SYNDROME*

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Mikulicz's disease and syndrome constitute problems of considerable clinical interest. Patients afflicted usually consult an ophthalmologist. The report by Haltenhoff,[1] an ophthalmologist, 1889, mentions a report by Gallasch,[2] 1874, of this syndrome in relation to leukemia. Mikulicz,[3] in 1888, presented a case at a medical meeting and first published his article in 1892. Following his description, the disease has come to bear his name. E. Fuchs,[4] 1891, published a case as lacrimal lymphosarcoma; and Zirm,[5] 1892, reported the syndrome, presumably caused by erysipelas. Following these pioneers, numerous reports have been published from all over the world.

The Mikulicz report described bilateral, painless, swollen upper eyelids associated with a nodular form of tumor of the lacrimal glands, unattached to the skin, and with a similar involvement of the parotid and submaxillary glands. There were no signs and symptoms associated with general health. The process remained local, ran a fairly long course, and regressed. Microscopic examination of sections of the glands showed masses of small round cells, lymphoid in character, fine reticulum, increase of fibrous stroma, and the remaining acini unchanged.

REPORT OF A CASE

A report of a case (WA 783,394) apparently showing a primary lesion in the lacrimal gland, the pure "Mikulicz" type, follows:

History. The patient, a Negro, aged 19 years (fig. 1), was admitted to the Receiving Hospital October 10, 1941, and was discharged November 17, 1941. For three months he had a painless and gradually increasing swelling of the left upper lid and slight protrusion of this eye. Two weeks before admission the right eye began to assume a similar appearance and course. He entered the Hospital because of disfigurement.

Eye examination. There was no diplopia. There was some reduction of tears. Examination of the left eye showed proptosis (fig. 2) and the appearance of an inward deviation. There was a fixed tumor mass, the size of a hickory nut, in the upper outer aspect of the orbit. The lacrimal gland area of the right eyelid showed swelling and a movable tumor the size of an almond. Conjunctivas and the movements of the extraocular muscles were normal. The pupils were equal and reacted to light and accommodation. There was no fever.

Fig. 1 (Heath). *WA 783,394.* Pure type of Mikulicz showing bulging of lids associated with nodular growth and the illusion of convergent squint with ptosis.

* Presented at the 83rd annual meeting of the American Ophthalmological Society, Hot Springs, Virginia, June, 1947. From Wayne University and Receiving Hospital, Detroit, Michigan, Departments of Pathology and Ophthalmology.

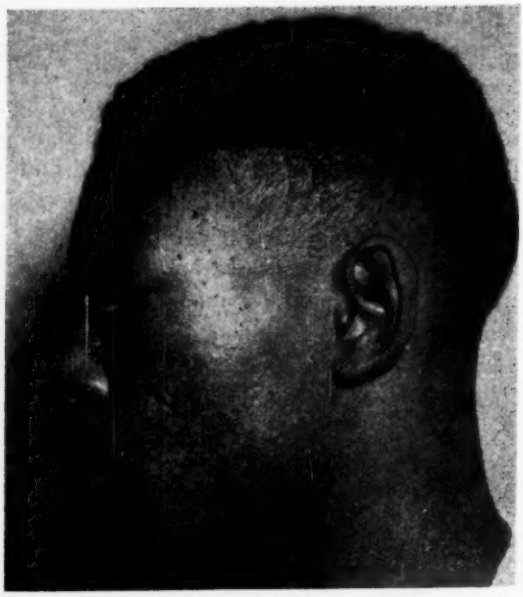


Fig. 2 (Heath). *WA 783,394.* Lateral view showing proptosis of the left eye.

Laboratory tests. O.T. (old tuberculin) test, in a dilution of 1:10,000, was negative at 48 hours. Blood Kline test negative. Hemoglobin, 14 gm.; erythrocytes, 4 M; white blood cells, 6,800; neutrophiles, 78; lymphocytes, 18; urea, 21. Urinalysis was negative, except the first specimen which showed a 3+ albumin (possibly á contamination).

X-ray examination. Orbit: October 10th and 15th, showed no orbital bone destruction. Chest: October 10th, showed no areas of infiltration. Hands: October 10th, showed no pathologic condition of the bones.

Surgery. On October 22nd, a biopsy of the left lacrimal tumor was done. On November 4th, the left lacrimal gland was removed through the conjunctiva, and on November 11th, the right gland was removed through the skin (fig. 3).

Microscopically, the sections of the tumor showed a moderate number of nests of epithelioids and lymphoid follicles with open centers, and occasional giant cells. There was no caseation and a marked fibrosis replaced reticular and acini tissue. A well-advanced lymphogranulomatosis was present in the stage of healing by sclerosis and scar formation (figs. 4 and 5).

Additional case histories

Following are some brief case histories illustrating Mikulicz's syndrome with different etiologies, namely, tuberculosis and sarcoid, syphilis, gout, and rheumatism, and giant-cell follicular hyperplasia. Other etiologies could be added, such as leukemia, lymphosarcoma, uveoparotid fever, and, relatively rare, Hodgkin's disease.

Case 1

History. R. E., a Negro, aged 21 years, was admitted on August 13, 1929, to the Receiving Hospital, and discharged on October 13, 1929. He had a progressive painless enlargement of the parotid and submaxillary glands of one year's duration, with progres-

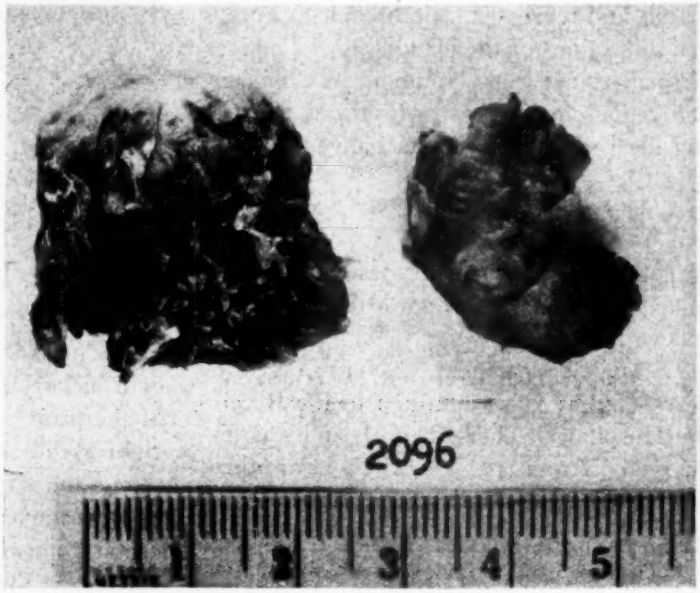
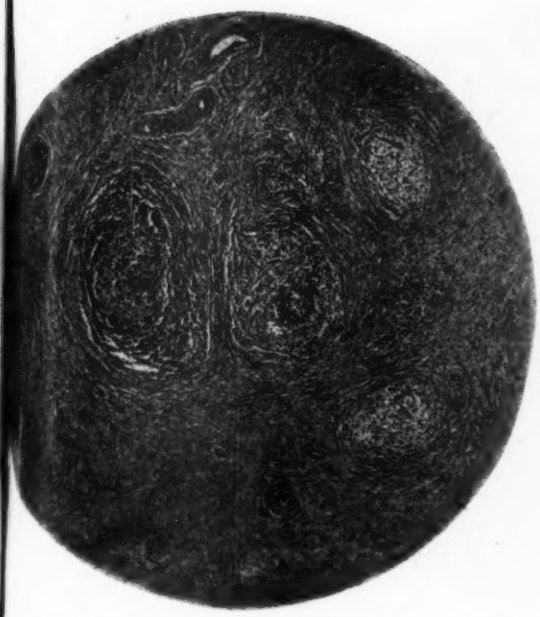


Fig. 3 (Heath). *WA 783,394.* Gross appearance of the tumor masses removed from the left orbit.



g. 4 (Heath). *WA 783,394.* Low-power view of tissue oved from the orbit, showing typical follicles with the ggerated scar formation and atrophy.

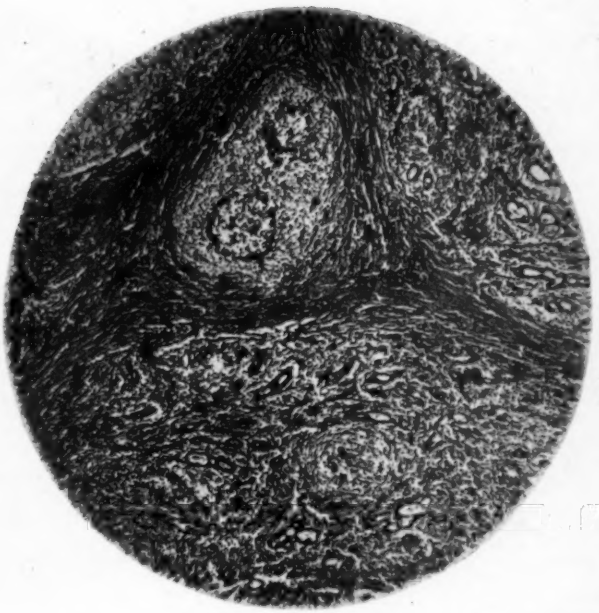


Fig. 5 (Heath). *WA 783,394.* High-power view showing nest of lymphocytes, epithelioids, occasional giant cells, a granuloma, without caseation and marked fibrosis. Apparently healing by sclerosis and scar.

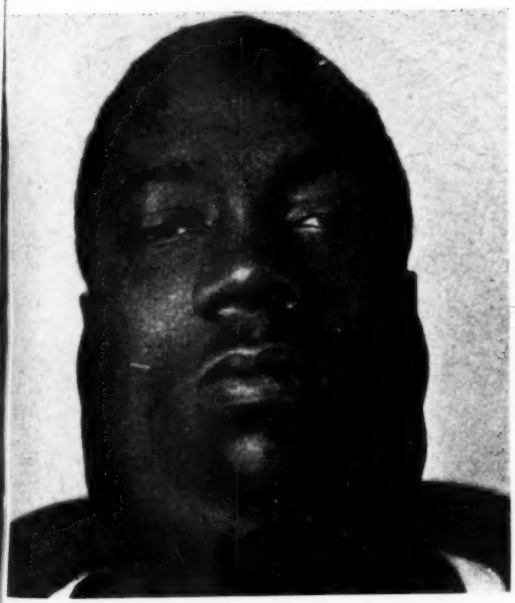


Fig. 6 (Heath). *Case 1.* Front view showing marked enlargement of the parotid and submaxillary glands in a tuberculous lymphadenitis.

Fig. 7 (Heath). *Case 1.* Lateral view of tuberculous lymphadenitis showing preauricular and submaxillary and less obvious ocular and lacrimal gland involvement.

Fig. 8 (Heath). *Case 1.* Microscopic section through the biopsy material showing typical lymphadenitis, tuberculous type, with giant cells and caseation.

Fig. 9 (Heath). *Case 2.* Low-power view of biopsy of lacrimal gland showing sarcoid, lymphogranulomatosis and Schaumann bodies. No caseation. Moderate fibrosis and lymphatic nodules

Fig. 10 (Heath). *Case 2.* High-power, showing t structure of giant cell and follicle.

sive weakness (figs. 6 and 7). On March 22, 1929, he had been admitted to the hospital with a complaint of progressive enlargement of the neck glands over a 5-year period. There was associated redness of the eyes. Examination revealed parotid and submaxillary enlargement associated with cervical lymphadenopathy. The patient refused biopsy, and was released.

Physical examination. On August 13, 1929, there was bilateral massive enlargement of the submaxillary and parotid glands, indurated and well circumscribed, as well as edema of the upper lids (fig. 8).

X-ray examination on March 22, 1929, showed minimal infiltration of the right upper lobe of the chest. On August 13th, the films showed massive bilateral tuberculosis with cavitations.

Course. Rapidly downhill.

Autopsy. Extensive bilateral pulmonary tuberculosis with apical cavitations. Tuberculous parotitis. Cervical adenitis.

CASE 2

History. E. A., a Negro, aged 29 years, was admitted to the Receiving Hospital on September 1, 1946, and was discharged on October 7, 1946. His chief complaint was conjunctivitis, edema of the upper lid, and nasal obstructions of one month's duration. P.H. was essentially negative.

Physical examination. Temperature was 99°F.; pulse, 64; blood pressure, 112/84 mm. Hg. Examination of the eyes showed congenital nodular conjunctivitis and associated firm, bilateral enlargement of lacrimal glands—palpable, nontender. There was preauricular tenseness over the parotid region. There was granular infiltration of nasal mucosa.

Laboratory tests. W.B.C., 8,850; differential—neutrophiles, 70; lymphocytes, 20; monocytes, 8. Repeated sputum examinations were negative for acid-fast bacilli. Serology: Positive Wassermann.

Course. A biopsy of lacrimal gland was illustrative of sarcoid (figs. 9 and 10). The patient improved.

CASE 3

History. I. H., a Negro, aged 34 years, was admitted to the Receiving Hospital on March 22, 1938, and was discharged on April 11, 1938. His complaint was enlargement of the lacrimal and parotid glands and conjunctivitis, low grade.

Physical examination. There was bilateral, firm painless enlargement of the lacrimal and parotid glands with mild inflammation. The right pupil failed to react to light and accommodation. There was a perforated nasal septum and ulceration of palate.

Laboratory tests. Serology was positive.

X-ray studies. Chest negative.

Course. Antisyphilitic treatment. Rapidly improved.

CASE 4

History. E. C., a Negress, aged 15 years, was admitted to the Receiving Hospital on February 24, 1947, and was discharged on March 8, 1948. She had stiffness of joints, fatigue, anorexia, and skin rash on abdomen and left ear. She had a history of fairly typical rheumatic fever beginning January, 1944, with associated remissions and exacerbations. In January, 1946, she was admitted to the University Hospital, and after two subsequent admissions, a diagnosis of sarcoidosis was made on lymph-node biopsy. The nodes decreased in size, but three weeks prior to admission to the Receiving Hospital, the patient showed exacerbation of symptoms associated with generalized lymphadenopathy.

Physical examination. The temperature was 99.6°F.; pulse, 120; blood pressure, 106/70 mm. Hg; respiration, 24. Positive findings included: (1) Enlarged nodes of rubbery consistency, submental, cervical and pre- and postauricular and axillary positions. (2) Abdomen—Large hyperpigmented erythematosquamous eruptions with indefinite

borders. (3) Bilateral lacrimal and parotid enlargement.

Laboratory tests. Hematology: Hemoglobin, 10 gm.; W.B.C., 17,700; neutrophiles, 86; lymphocytes, 9. Toxic alteration of neutrophiles. Bone marrow negative.

X-ray examination. Bones of hands showed periarticular demineralization.

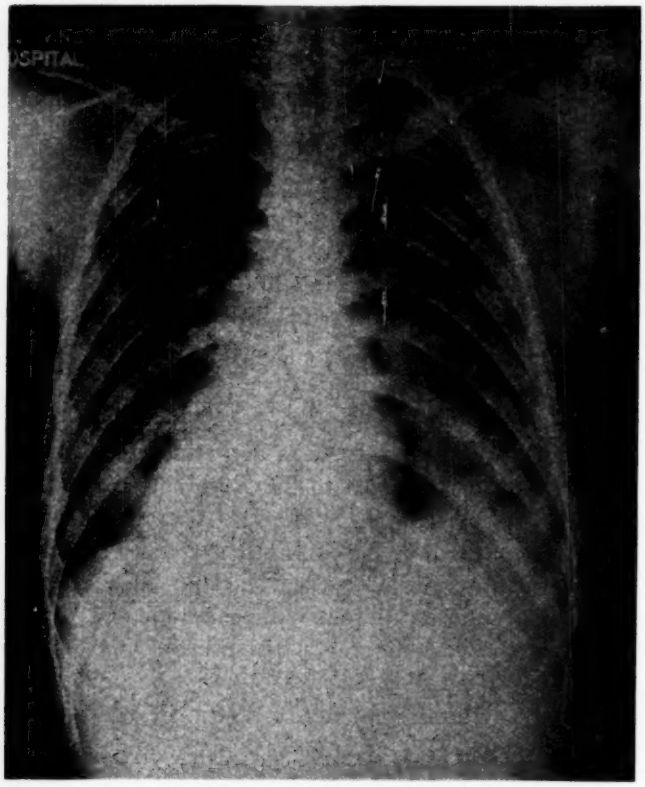


Fig. 11 (Heath). *Case 4.* Shows typical lung field and a diffuse fibrosis as seen in sarcoid.

Chest: Lung fields showed reticular pattern of opacity in all lobes, but heaviest in the bases; relatively little hilar adenopathy (fig. 11).

Lacrimal gland biopsy. Moderate interlobular and periductal fibrosis, illustrative of gout.

CASE 5

History. J. F., a Negress, aged 43 years, was admitted to the Receiving Hospital on June 15, 1946, and was discharged on July 8, 1946. She suffered from malaise and polyarthritis. There was edema of the lacrimal, parotid and salivary glands, of six weeks' duration, and conjunctivitis of one week's duration. P.H. was essentially negative.

Physical examination. Temperature, 99° F.; pulse, 88; respiration, 22; blood pressure, 140/95 mm. Hg. There was bilateral swelling of the lacrimal gland. Funduscopic examination revealed early arteriosclerotic vessel changes.

Laboratory tests. Serology was negative. Hematology and blood chemistry within normal limits. Sedimentation rate elevated.

Course. The patient refused biopsy. She was placed on salicylate.

Discharged markedly improved. Illustrative of rheumatism.

CASE 6

History. L. W., a Negro, aged 27 years, was admitted to the Receiving Hospital on December 14, 1936, and discharged on December 22, 1936. He had had progressive enlargement of the inguinal lymph nodes for one year, with parotid and submaxillary gland enlargement for three months (fig. 12).

Physical examination showed temperature, pulse, and respiration to be normal. Blood pressure was 130/90 mm. Hg. There was mild conjunctivitis and bilateral, painless, soft enlargement of parotid and submaxillary glands, as well as generalized lymphadenopathy.

Laboratory tests. W.B.C., 5,450; lymphocytes, 34. Serology negative. Sputum negative.

X-ray examination. Chest revealed advanced bilateral tuberculosis.

Course. Biopsy of epitrochlear node revealed acute noncaseating adenitis and giant-cell folliculosis. Biopsy of submaxillary gland refused. The patient was discharged on release. There was no follow-up. This case illustrates giant follicular hypertrophy.

Fig. 12 (Heath). *Case 6.* Low-power view showing giant cell follicular hyperplasia.

Comment

Possible confusion in diagnosis is illustrated by the cases cited. There are many agencies causing physical signs of the syndrome, especially if the swelling is bilateral and includes the lacrimal, parotid, and maxillary glands (table 1).

The physiology and environment of the lacrimal gland renders it susceptible to deterioration from the edema and swelling resulting from any injurious agency. The gland has a fair blood supply and long periods of activity, a tight compact lobular structure surrounded by fibrous and lymphoid tissue. The gland is contained in a rather rigid environment between bony fossa, globe, and orbital septum, all limiting expansion, except at the price of pressure, atrophy, and fibrosis.

TABLE 1

AGENCIES CAUSING LACRIMAL GLAND TUMEFACTION

Congenital hypertrophy	Infections in gland, as sarcoid, tuberculosis, syphilis leprosy, virus (as mumps)
Simple hypertrophy (exaggerated physiology)	Rickettsia (as Q fever)
Trauma (including surgical)	Tularensis, oculoglandular fever
Foreign body	Uveoparotitis
Mechanical block (scarring and shrinking of conjunctiva, salivolithiases, calculus)	Extensions from skin as erysipelas from conjunctiva, keratoconjunctivitis
Chemicals and drugs (iodine, lead)	Leptothrix, sporothrix, blastomycosis, dachryoadenitis
Gland hypersensitivities and allergy	Neoplasms, as sarcoma, mixed cell, cylindroma, lymphoblastoma, and so forth
Metabolic diseases (gout, rheumatoid)	Leukemia
Parasitic (?trichinosis)	Hodgkin's disease
Blood dyscrasias	
Any acute xanthematous infection	

Microscopic studies of a biopsy material, made at only one stage sometimes, confuse unless the whole process has been followed from early through to the late stages. The structure of the gland and the lymphoid tissue present favors an inflammatory response by formation of granulomas. The structural and environmental factors mentioned above lead to early atrophy and fibrosis and the development of a lacrimal cicatrix. The clinical and morphologic findings, therefore, are often confusing.

One enters the realm of lymphomatous lesions ranging from benign simple hypertrophy and hyperplasias—transitional stages

—to various forms of neoplasm. The lymphatic, hematopoietic, reticular tissues are difficult to classify.

Invasion of the gland by small lymphocytes is interpreted by some as a hyperplasia of the lymph elements and by others as a reaction of chronic inflammation. Others have noted that Mikulicz's disease in some cases is only a stage progressing from lacrimal lymphomas to ultimate concomitant, general lymphatic and hematopoietic involvement (Howard)[6]. Others present evidence against the theory of progression from Mikulicz's disease proper to pseudoleukemia to leukemia (Schaiffer and Jacobson)[7].

The evidence of a chronic, benign (over 10 to 15 years), clinical course is strong for a purely local disease. Other evidence is to be had from a study of biopsy material showing a limited lymphoid reaction and an early cicatrix, and a different, less sensitive response to radiation therapy from that of malignant lymphoma as has been pointed out by Leucutia and Price.[8]

Classification

Publications by Jackson, Parker, and Bethea,[9] and by Callender,[10] 1943, from material of the Lymphatic Tumor Division of the An erican Registry of Pathology give useful classifications. Gall and Mallory,[11] 1941, published a survey of "Malignant Lymphoma" offering a classification on a cellular basis, correlated with the clinical course. A general study of lymphatics, and so forth by Drinker[12] is useful. V. Brunn[13] classified with two main classes—those with and those without blood changes. Howard[6] concluded that Mikulicz's disease is not an entity. Thursfield's[14] classification provides for eight groups:

I. Congenital, familial or hereditary
II. Mikulicz's disease proper
III. Mikulicz's disease proper with involvement of lymphatic apparatus
IV. Leukemia
V. Tuberculosis
VI. Syphilis
VII. Gout
VIII. Sialodochitis fibrosa

Schaiffer and Jacobson[7] classify as follows:

I. Mikulicz's disease
A. Familial
B. Mikulicz's disease proper
II. Mikulicz's syndrome
A. Leukemia
B. Tuberculosis
C. Syphilis
D. Lymphosarcoma
E. Toxic
1. Lead
2. Iodides, and so forth
F. Gout
G. Febris uveoparotidea subchronica

Discussion

It is not the purpose of this paper to report the clinical findings related to a cellular classification of tumors of the ocular adnexa (McGavic[15]). Our purpose is to call to the attention of ophthalmologists some diseases of the lacrimal gland and related lymphadnexa. These lesions have features in common other than their location. We list in Table 1 some causes of lacrimal disease. It is clinically possible to find these causes. Lacrimal gland disease is probably more important than the frequency of its treatment suggests. Clinically, one rarely directly attacks the gland. To disentangle etiologic possibilities requires a number of studies. One may employ history, inspection, palpation, X-ray films, blood studies, examination for parasites, paper-strip studies of tears, intravital dyes, corneal studies of an associated keratitis, study of conjunctiva and smears, inspection of the lacrimal drainage apparatus, and the use of biopsies.

Tuberculosis as a rule shows caseation necrosis, loss of reticulum, smaller (Langhans) giant cells, infiltrative loss of acini, fibrosis different in character from sarcoid, and characteristic progress in the involve-

ment of other organs. The organisms may be stainable.

Sarcoid, in nearly half of the tissue sections, shows large foreign-body giant cells with inclusions (Schaumann bodies). The reticulum is present with a more normal appearing fibrosis and, as a rule, no coagulation necrosis. Other parts of the body may show sarcoid lesions—skin, viscera, lungs, bone, and so forth, and the whole process may characteristically be held in abeyance for irregular intervals.

Syphilis shows lymphocyte infiltration about vessels, the granuloma are firmer, less diffuse, and more vascular. Other over-all changes of syphilis will be present.

The clinician has to determine whether the nodule in the lacrimal gland is a self-limiting or an expanding inflammation, or neoplastic in character. Leinfelder and O'Brien[16] report the rarity of simultaneous involvement of orbits and lids in other forms of tumor.

Sarcoid and tuberculosis differentiation may be seen in Table 2. The lesions illustrated here, of the Mikulicz "pure type," are partly healed and illustrate a predominance of fibrosis and atrophy of the normal gland structure. The follicles in other patients studied late in the disease may be very rare, and giant cells still more rarely seen. The cracking phenomenon is seen hardly at all and then is only partially represented. At times a foreign body giant cell is found in the midst of, and in spite of, an extensive fibrous environment.

Early lesions show polymorphic granulomas, lymphocytes about the vessels, some

TABLE 2

DIFFERENTIATING TUBERCULOSIS AND SARCOID

Tuberculosis	Sarcoid
More of a proliferative endarteritis	A reticulo-endothelial system disease
Lesions usually move along to either healing or breakdown	Spontaneous regression common, periods of abeyance. Lesions may remain unchanged
Dissemination obvious, course relatively visible	Clinical manifestations variable, depend on organ involved
Distribution is wide; most rarely in striate muscles. Shows zonation	Descrete lesions. May occur in striate muscles
Does not enter through vessel walls. May be found on endothelial side	May enter vessel walls and go through to endothelium
Giant cells common, of Langhans type. No Schaumann bodies. More giant cells, in lymph relatively; more rare in lungs	Giant cells common, of foreign body type. Schaumann bodies common, 30 to 40 percent. Less in lymph; more common in lung
Caseation necrosis is the rule	Caseation rare
Cavity formation characteristic	In lung, cystlike spaces and emphysema
Concentric growth characteristic	Concentric growth absent
Epithelioids and eosinophiles not characteristic	Epithelioids common; eosinophiles in 10 percent
No reversal of albumin-globulin ratio	Reversal of albumin-globulin ratio
Healing is concentric, fibrous	Healing is fibrous, diffusely laid down
Reticulum lost	Reticulum present
If tuberculin test is negative, lesions may show stained organisms	If tuberculin test is negative, lesions do not show acid-fast organisms

instances of phagocytosis, red and giant cells, and sometimes eosinophiles. The acini are compressed and/or disorganized; the reticulum is compressed. Some authors distinguish two forms of lesion—lymphomatous and granulomatous. However, the characteristics of each may be found in the same tissue.

Summary

A report is given of a case of "pure" Mikulicz's disease. Similar lacrimal gland enlargements due to different agents—tuberculosis, sarcoid, gout, syphilis, and giant follicular hyperplasia—are reported. Attention is called to confusion in diagnosis. A table is supplied listing some factors and causes of tumefaction of the lacrimal gland.

Resemblances between the lesions of "pure" Mikulicz's disease and sarcoid are described. A comparison between tuberculosis and sarcoid pathology is outlined.

Conclusions

A considerable number of agents may cause tumefaction of lacrimal and accessory lacrimal glands. The differential diagnosis is made by studying the state of the general health of the patient, by following the course of the disease, and by making local ocular studies and biopsies. Confusion exists, especially between tuberculosis and sarcoid. This usually can be resolved. So-called "pure" Mikulicz's disease probably is a granulomatous response of lymphatic tissue of the reticuloendothelial system to a stimulus. This stimulus may be infectious, parasitic, or chemical. Many lacrimal gland reactions are reversible while others resolve by fibrosis to a lacrimal cicatrix. If the latter is extensive enough, the cornea inevitably suffers.

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OPERATIVE FAILURES FOR CHRONIC SIMPLE GLAUCOMA*

A HISTOLOGIC STUDY

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A study of eyes removed after operative failures for chronic simple glaucoma shows that ideal surgical relief has not been devised as far as the laboratory is concerned. The examination of approximately 100 operated eyes with glaucoma at the New York Eye and Ear Infirmary showed at least three characteristics: (1) Adhesions between the iris and the cornea; (2) closure of new filtration channels with fibrosis; and (3) inflammation of the uvea.

Synechias between the anterior surface of the iris and the posterior surface of the cornea are composed of such dense connective tissue that permanent separation by operation is almost impossible. The artificial filtration channel or channels become closed by the proliferation of connective tissue, despite an iris inclusion in the operative wound. Progressive iridocyclitis usually requires enucleation.

Operations for glaucoma which illustrate the general microscopic findings of all globes sent to the laboratory for study are iridectomy, iridencleisis, and trephination. These eyes show in common the following characteristics.

1. Pathologic changes in the corneal epithelium.
2. Thinning of the cornea and sclera.
3. Inflammation at the limbus.
4. Shallowness of the anterior chamber.
5. Adhesions of the iris to the cornea and lens.
6. Inflammation of the iris and ciliary body.
7. Changes in the crystalline lens.
8. Pathologic depression of the optic nerve.
9. Atrophy of the ganglion cells of the retina.
10. Unusual findings in the vitreous body.

The object of this paper is to show the causes of failures in the usual operations performed for the relief of chronic simple glaucoma. In order to show the histologic changes in the disease, it is necessary to review briefly the microscopic anatomy of the normal globe.

THE NORMAL EYE

The eye is composed of a comparatively avascular fibrous tunic consisting of the cornea and sclera, both a millimeter or less in thickness, enclosing the uvea and the transparent contents of the globe. The

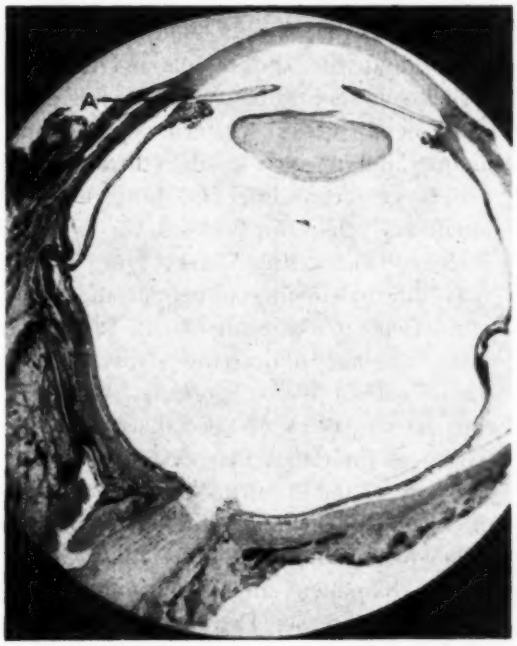

Fig. 1 (Payne). Normal globe. (A) Iris angle.

* Presented at the III Pan-American Congress of Ophthalmology, Havana, Cuba, January 4 to 10, 1948. From the Department of Pathology, New York Eye and Ear Infirmary and the New York University College of Medicine.

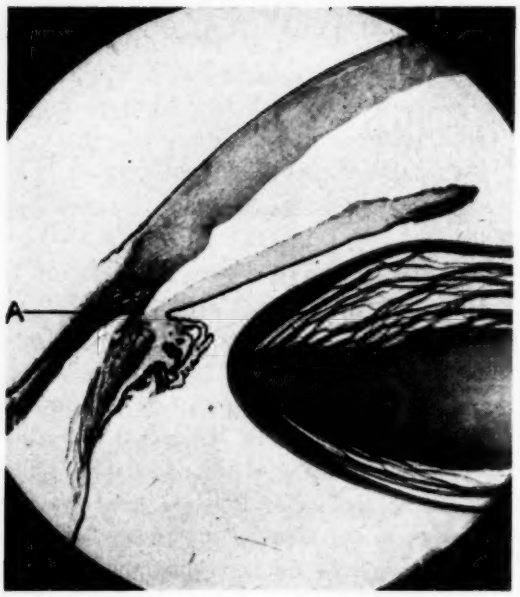

Fig. 2 (Payne). Normal angle of the iris (A) enlarged.

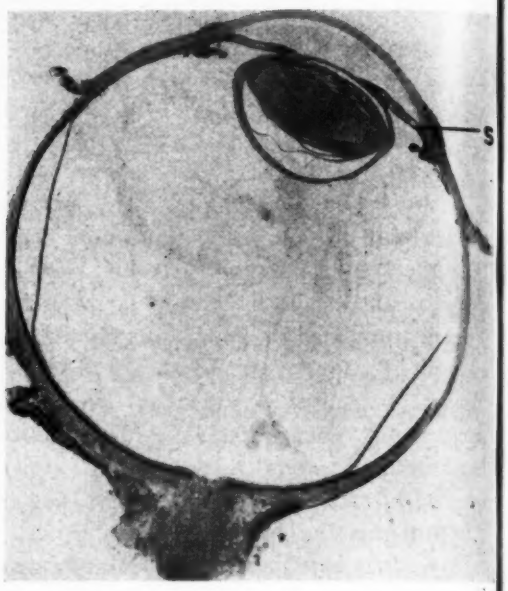

Fig. 3 (Payne). Subacute glaucoma with shallow anterior chamber and peripheral anterior synechias

lamina cribrosa is a continuation of the sclera to form a meshwork across the optic canal.

A section of the cornea shows that it consists of five layers and from without inward they are: the epithelial layer, Bowman's membrane, the stroma, Descemet's membrane, and the endothelium. The normal cornea contains no blood vessels nor medullated nerve fibers. Corneal epithelium is unique in that it is visible throughout its five layers, including its most superficial squamous cells. Bowman's layer is a thin, homogenous, acellular layer lying immediately internal to the epithelium and serving as a basement membrane for it. It gradually fuses into the underlying stroma and becomes one of its components. The stroma consists of layers of specialized connective tissue, so interlaced that clean separation is impossible, and it forms nine tenths of the thickness of the cornea. Descemet's membrane has an inner cuticular and an outer elastic component and is quite resistant to trauma or disease. The innermost endothelial lining consists of a single layer of flattened cells which become quite thin over the pectinate processes and the anterior surface of the iris.

The limbus corneae

The limbus is a concentric segment measuring 0.75 mm. anteroposteriorly at the junction of the cornea and sclera, and containing characteristics of each. The fibrous tunic is reduced in thickness in this area by the indentation of the scleral sulcus externally and the scleral-furrow internally. The external sulcus is filled in with fine, loose aerolar connective tissue permeated by blood vessels which end in small capillary loops at the corneal margin. The surface is covered with thickened stratified squamous epithelium, which is arranged in folds and is undergoing transition to bulbar conjunctival epithelium. The scleral furrow or the internal depression of the limbus is filled in with a meridional meshwork of endothelial-covered strands known as the ligamentum pectinatum. Schlemm's canal is in close relation to the outer bounds of the furrow. Anterior ciliary veins connect with the drainage channels which transport aqueous from the anterior chamber.

The sclera

The sclera is that portion of the fibrous tunic which extends from the limbus corneae to the optic canal. It is composed of dense connective tissue and varies in thickness from 1 mm. at the posterior pole to 0.5 mm. beneath the insertions of the extraocular muscles. For descriptive purposes, the sclera has three layers: the loose, mildly vascular episcleral connective tissue; the dense, almost avascular, areolar connective tissue forming the middle and greater thickness of the structure; and the inner or "lamina fusca" which is only differentiated from the middle layer by chromatophores in its interspaces.

The lamina cribrosa is a weblike continuation of scleral fibers across the optic canal. It contains collagenous and elastic fibers intermingled with glial components. Normal horizontal sections through the optic nerve show that there is continuity in curvature of the cribriform plate corresponding to that of the sclera. It is evident that it is the weakest portion of the fibrous tunic and will be first to become distended by pressure from within the globe.

The uvea

The uvea consists of the choroid ciliary body and iris. The choroid may be described as the vascular layer lying just internal to the lamina fusca of the sclera. It is composed of three ill-defined series of blood vessels as follows: An outer layer of large-sized blood vessels, a middle layer of intermediate-sized vessels, and an internal layer composed of a single row of capillaries adjacent to the lamina vitrea of the choroid. Interspersed between these various layers of blood vessels are chromatophores and a fine reticulum of connective tissue and endothelial elements.

The ciliary body is composed essentially of the same layers as the choroid, but differs in that the ciliary muscle is interposed. The ciliary muscle is made up of three parts; an inner circular series of fibers connected with outer meridional fibers by a series of radiating fibers. The ciliary muscle gives size and shape to the ciliary body. Internal to the muscle layers are the continuations of the vascular choroidal layers with the exception of the choriocapillaris. The pigment epithelium is a continuation of the pigment epithelium of the retina and the ciliary epithelium is the same as the retina reduced to a single layer of the nonpigmented cells.

The principal blood and nerve supply is from the long posterior ciliary vessels and nerves.

The iris may be divided into an anterior or mesodermal portion and a posterior or ectodermal derivative. The former consists of three ill-defined layers: the endothelium, the anterior border layer, and the vessel layer. The posterior portion of the iris is composed of a dilator pupillae and the pigment epithelium of the iris. The anterior endothelium is peculiar in that its surface is abruptly broken at the margins of the crypts and aqueous is permitted to come into direct contact with the stroma. The anterior border layer is characterized by a slight condensation of the fibrous tissue beneath the endothelium. The number of chromatophores contained in this layer determines the color of the iris, the more chromatophores, the darker the iris. The vessel layer of the stroma of the iris is composed of delicate, loose connective tissue supporting numerous blood vessels, which appear to have thickened walls. No elastic fibers are found in the iris except in the walls of the blood vessels and at its union with the ciliary body. The constrictor and dilator pupillae muscles are derivative of the pigment epithelium and the latter forms the outer lead or the ectodermal portion of the iris. The constrictor is easily seen in most preparations but the dilator is thin and obscured by the pigment epithelium or the inner leaf of the iris. The circulation is through the radicals from the greater arterial circle, which lies in the anterior part of the ciliary

body and is supplied by the long posterior and anterior ciliary vessels.

The retina

The retina is a thin transparent structure composed of nine layers, the outermost being the rods and cones and the innermost being the internal limiting membrane. It lies in apposition but not attached to the pigment epithelium, a single layer of cells separating it from the choroid. The retina is anchored only at the ora serrata and around the margin of the optic disc. It has a dual blood supply, the inner five layers receiving nutrition from the central artery and accompanying vein. The outer four layers are supplied by the choriocapillaris. The optic nerve begins with the papilla, a flat round projection just inside the globe measuring 1.5 mm. in diameter. It lies 1 mm. below and 3 mm. nasally to the posterior pole of the eye and corresponds to the intraocular portion of the nerve. The elevation is caused by an accumulation of nonmedullated nerve fibers from the ganglion cells of the retina. A central depression lies on the surface. It is in this depression that the central retinal vessels emerge. The fibers arrange themselves in the interstices of the cribriform plate and just posterior to it they assume medullation and become arranged into bundles. Posterior to the globe, the nerve is covered by the pial and dural sheaths, with the arachnoid lying between. At approximately 15 mm. posterior to the globe, the central retinal vessels enter the nerve at right angles and proceed forward in its center to appear in the depression of the papilla. The bundles are so arranged that regular rows of nuclei from the septa follow a course parallel to the long axis of the nerve. The blood supply is from the vessels of the sheaths, the central vessels, and the circle of Zinn.

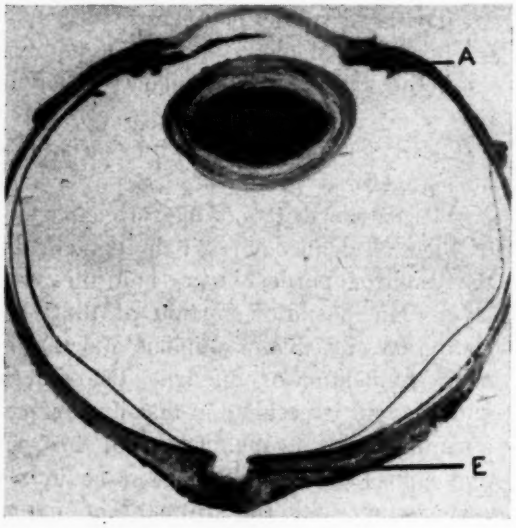

Fig. 4 (Payne). Iridectomy operation (A) shows stump of iris extending toward apex of cornea, adhesions remain.

Contents of the normal globe

The contents of the globe are aqueous humor, the crystalline lens, and the vitreous body. Under normal conditions, the aqueous does not appear in sections. The lens is often distorted in the process of fixation and staining. The vitreous may be displaced or compressed. In the presence of glaucoma, all three of these elements may show definite findings which contribute to the pathologic picture. The aqueous may show albuminous changes with cells and fibrin in suspension, the lens may be pushed forward and swollen, and the vitreous may contain fragments of pigment and other evidences of degeneration.

Iridectomy operations

An eye (fig. 4) demonstrating most of the usual microscopic findings after unsuccessful iridectomy operations shows generalized thinning of the fibrous tunic with edema and absence of the corneal epithelium. The operative wound is closed by dense connective tissue in which some of the iris pigment remains. The stump of the iris extends toward the center of the cornea and is adherent to it, showing that the synechia is just as extensive as it was before the operation was performed. In other words, the normal iris angle is not restored

and the adhesions are not relieved.

Further study of the specimen shows considerable edema and round-cell infiltration at the limbus which extends into the operative wound. The cornea is somewhat thinner than normal and the epithelium is undermined in the periphery, swollen and absent over the center. Bowman's membrane is intact except in the region of the limbus, where pannus is beginning to form. A membrane is forming on the anterior surface of the iris, and the endothelium is covered with a thin layer of round cells, fibrin, and pigment particles. The sclera is thinner than normal and shows little of importance. The iris is characterized by atrophy, broad anterior peripheral synechias, and chronic inflammation. The iris stump extends far anterior to the filtration angle which has been closed by adhesions. The membrane forming on the anterior surface of the iris, and contributing to the adhesions, has firmly sealed any possible connection with the normal drainage spaces. The ciliary body shows atrophic and inflammatory changes, and the choroid is flattened to a mere line by pressure and fixation. The retina shows destruction of the ganglion cells, edema, and cystic degeneration. The crystalline lens has been removed but its enlarged and forward displaced capsule remains. A fragment of iris lies on the anterior surface of the lens. Careful study of this specimen indicates that the iridectomy failed to create a new drainage channel and the synechias were undisturbed. The presence of inflammation contributed to the loss of the eye.

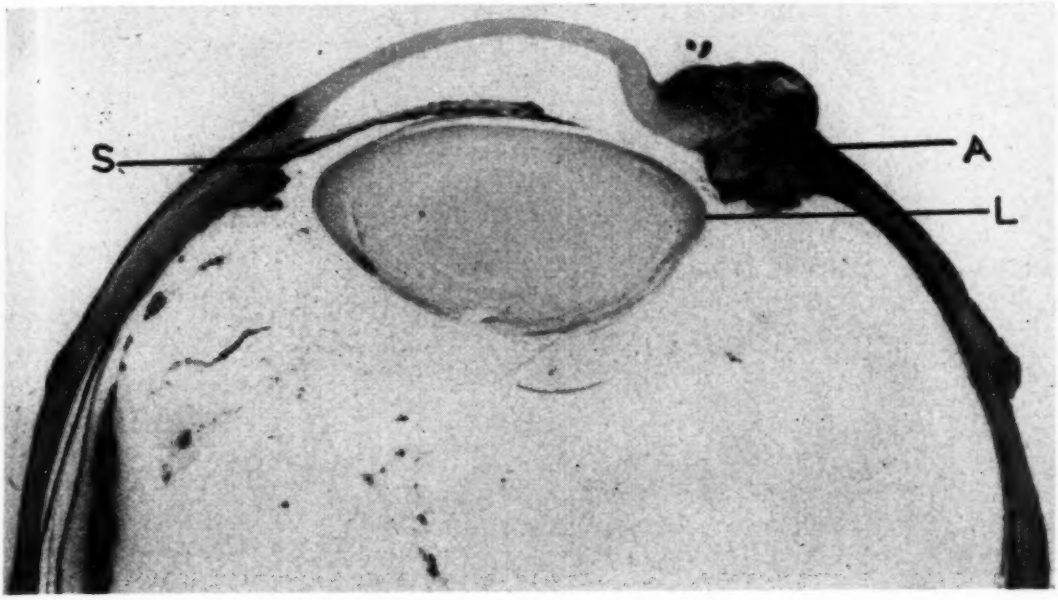

Fig. 5 (Payne). Iris inclusion (A) in operative wound; (L) crystalline lens; (S) anterior synechias.

Iridencleisis operation

An eye (fig. 5) removed after an unsuccessful iris inclusion operation shows atrophic uveal tissue in the operative wound, a shallow anterior chamber, and definite lens changes.

The fibrous tunic is distended and thinner than normal. The epithelium shows signs of edema and bullouslike formation near the operative wound.

A more intensive examination of the sections shows that the iris is included in the bleb and that filtration is possible. There is sufficient space between the conjunctival flap

and the iris for aqueous drainage. Unfortunately, the iris shows signs of chronic inflammation and firm diagonal adhesions, which unite the root of the iris to the base of the flap. Instead of acting as a filtration "wick," the iris forms a firm band which dams the aqueous behind it. There is no relief from increased intraocular pressure, which accounts for distention of the globe and formation of bullae on the cornea.

vessels with extravasations into the loose connective tissue. A small hemorrhage lies adjacent to the ciliary body. Diffuse lymphocytic infiltration and fibrotic changes complete the picture. The iris on the side opposite is drawn taut by its adhesion to the displaced lens. It is atrophic and diffusely infiltrated with lymphocytes. The ciliary body shares in the atrophic changes just mentioned.

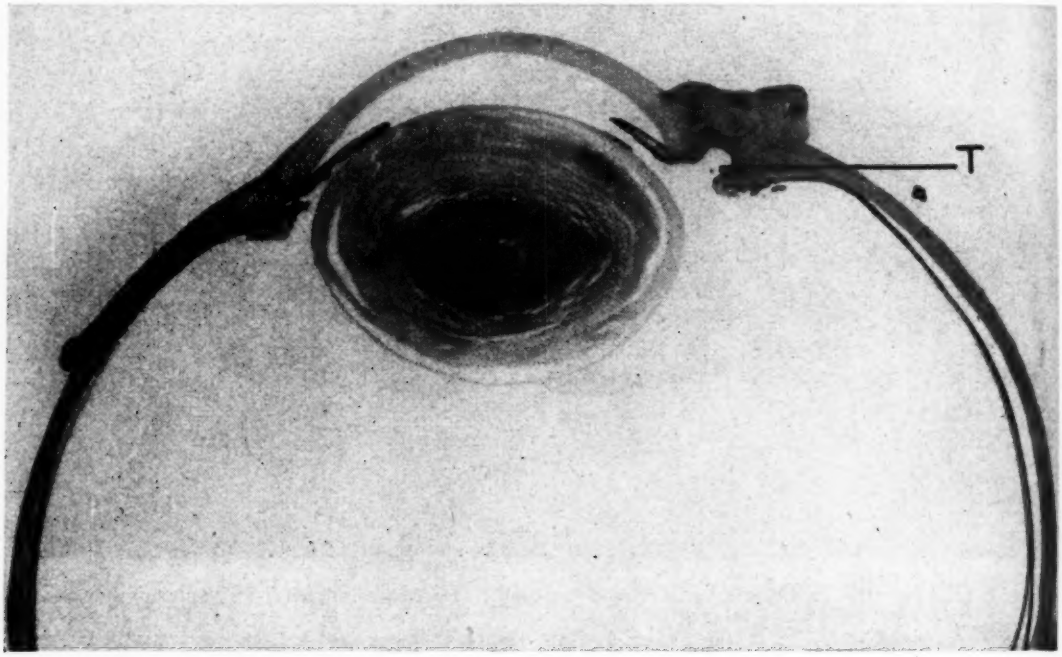

Fig. 6 (Payne). Unsuccessful trephining operation showing (T) operative wound.

The crystalline lens has moved in the direction of the filtration cicatrix. It is saved from complete dislocation by a firm adhesion of the pupillary area of the iris to its anterior capsule. The iris itself is almost diamond shaped in cross section and shows evidence of nuclear sclerosis. Some of the contraction of the lens cortex is due to hardening agents. Displacement of the lens is a fairly common finding after operations for glaucoma.

Most of the inflammatory changes in this specimen are in the vicinity of the operative wound. There is congestion of the blood

The eventual loss of this eye was due to the bandlike adhesion of the iris across the mouth of the operative wound, displacement of the lens, distention of the globe, and bullous keratitis.

Trephinations

Eyes (figs. 6 and 7) enucleated after unsuccessful trephinations may be illustrated by the description of a typical "failure."

The specimen shows that the anterior chamber is shallow, the crystalline lens is swollen, and the operative wound is closed by fibrous tissue. The cornea is irregular in

thickness. The epithelium is slightly undermined by new blood vessels and connective tissue at the limbus. The stroma is moderately infiltrated in the periphery. Descemet's membrane is curled in itself near the operative wound, and the endothelium is covered with a thin layer of fibrin. The operative wound is closed by dense connective tissue containing fragments of pigment, lymphocytes, and new blood vessels. The filtering cicatrix contains fresh hemorrhage. The iris is atrophic and is closely adherent to the cornea and lens on the unoperated side. An iridotomy has been performed as is shown by a part of the iris lying in the wound. The ciliary body and the choroid show atrophic changes with congestion of the blood vessels. The retina is undergoing degenerative changes with diffuse hemorrhage in its innermost layers. The crystalline lens shows cortical cataractous changes with nuclear sclerosis. The lens is in close relation to the filtration wound. The loss of the eye was due to fibrotic changes in the wound and close approximation of the lens.

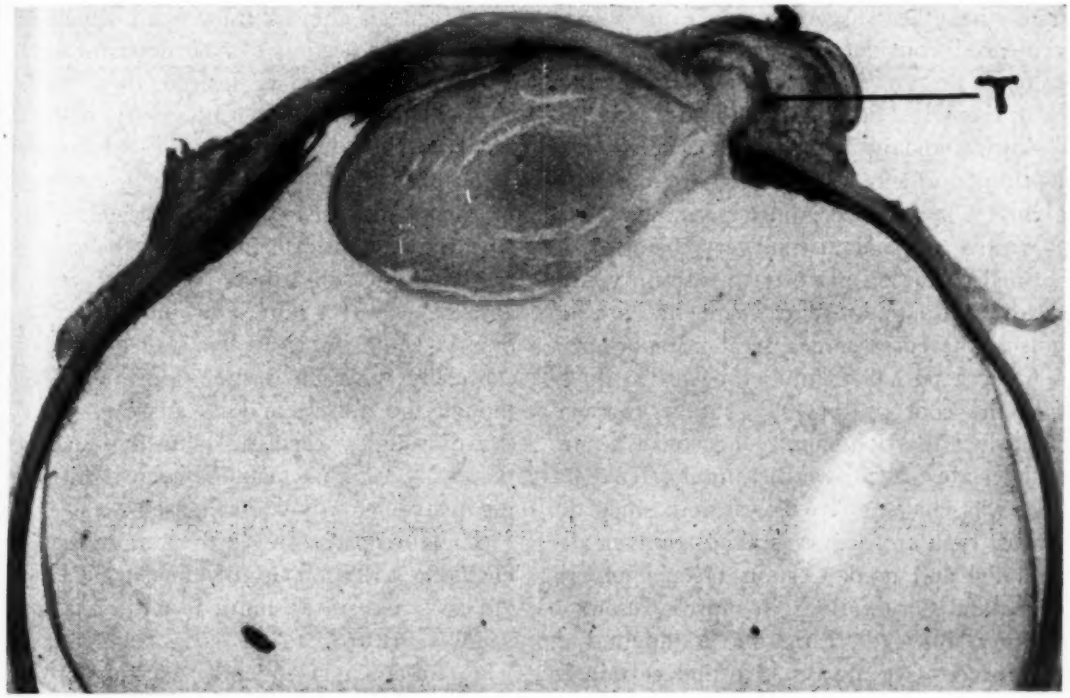

Fig. 7 (Payne). Operative failure after trephining operation, (T) showing herniation of crystalline lens.

Conclusions

1. Common pathologic changes are present in eyes removed after operative failures for chronic simple glaucoma.
2. Comparing the histology of normal eyes with that in chronic simple glaucoma may show the causes of operative failures.
3. Failure of the iridectomy operation may be due to persistence of synechias and not removing the iris at its roots.
4. Iris-inclusion operations may be closed by the iris itself.
5. Trephinations may become closed by fibrotic and inflammatory changes.
6. Specimens reviewed in the laboratory are operative failures.
7. Successful operations for glaucoma are not reviewed in the laboratory and far exceed the "failures."

17 East 72nd Street (21).

A TECHNIQUE FOR MUSCLE RESECTION WITHOUT THE USE OF THE PRINCE FORCEPS*

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It has often been my feeling when performing or observing ocular muscle resections in which various types of forceps, such as the Prince, Reese, or Worth, were used that the surgeon was being inconvenienced considerably by the forceps, in spite of the fact that the muscle was being held securely. Frequently, the forceps are awkward and in the way, especially when working on the relatively small eye muscle of a child where space is at a premium. With corrective strabismus surgery being performed more and more frequently in young children, this annoyance with the use of muscle forceps assumes greater importance.

Over a period of time I began to question the concept that the Prince forceps† furnished the ophthalmic surgeon a secure and certain fixation on the muscle. The concept was challenged with caution, since the Prince type of forceps is almost universally accepted and used. Certain specific experiences and observations in muscle resection surgery, however, cause me to doubt that the forceps are always safe and certain in their action.

In some instances, the forceps slip a small amount after being locked, and the final amount of resection obtained is less than anticipated. When the forceps are used to pull the distal end of the muscle toward the site of insertion in order to place sutures and later to tie them securely, there is tension on the muscle and the forceps are apt to slip, especially if the teeth are worn or do not approximate accurately. It may be argued that this is a fault in the instrument rather than with the technique. Nevertheless, the procedure is essentially dependent on the instruments.

An argument in favor of the Prince type of forceps is the accuracy with which the amount of resection can be determined. If a 10-mm. resection is desired, then the instrument is placed the necessary distance from the insertion. Here, too, the concept of accuracy has to be questioned. Although in theory the instrument is placed at the required distance planned for the muscle resection, actually there results a certain amount of stretching and pulling on the muscle while inserting the forceps. This is especially true in large resections, even though the muscle and its adjacent tissues are thoroughly cleaned. Thus the final resection is less than planned even if measuring instruments have been used.

The forceps create further annoyance by engaging a large part of the surgical field which is necessarily limited by the relatively small structure of the extraocular muscle. The surgeon is frequently working around the instrument, especially during the placing and fastening of the sutures, at which time diligent care has to be exercised in order to avoid tying the forceps to the muscle.

Finally, another moment of awkwardness is usually encountered when the forceps are removed. The teeth of the forceps may be so strongly entrenched in the muscle fibers that the surgeon has to exert his full care and delicacy in extricating the instrument. The sutures are already tied, and excessive tension in this region may loosen or even damage the sutures.

Although the use of muscle-resection forceps has shortcomings and limitations, nevertheless these instruments will continue to be employed unless another procedure

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† Since this particular type of forceps is widely used, the term "Prince forceps" will be used as generally referring to all types of resection forceps of similar principle.

can be devised which will eliminate or lessen the faults of the forceps. With this in mind the following procedure was initiated and developed. To date 29 muscle resections have been performed by this technique with increasing confidence in its value.

Surgical procedure

The conjunctival incision is made 6 mm. above the superior border of the muscle to be resected rather than over the muscle (fig. 1). In this way the small blood vessels about the muscle are avoided and all bleeding is eliminated. The original incision includes Tenon's capsule and extends down to the sclera. Following the exposure of the sclera and gentle dissection of the episcleral tissues with blunt-pointed conjunctival scissors, all cutting instruments are placed aside. The isolation and cleaning of the muscle is completed entirely with the use of strabismus hooks and ordinary eye forceps, and it is usual to accomplish this in a completely bloodless field.

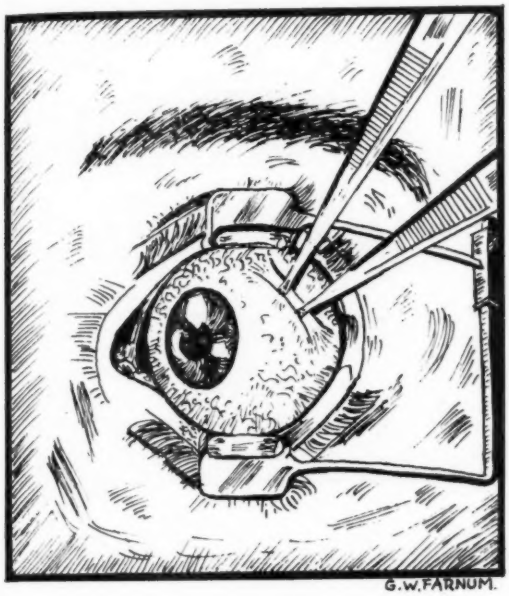

Fig. 1 (Yasuna). The conjunctival incision is made 6 mm. above the superior border of the muscle to be resected rather than over the muscle.

A double-armed, 3-0 catgut suture is placed through the muscle insertion from beneath (fig. 2), each arm of the suture being about 2 mm. from the muscle margin. The assistant now gently raises the distal end of the muscle from the sclera and each arm of the suture is placed through the muscle at the desired distance from the insertion depending upon the amount of resection planned (fig. 3). The suture is not pulled up but a loop of each arm is left loose both above and below the muscle to avoid severing the sutures where the muscle is cut. All suturing is performed before the muscle is sectioned. The muscle is now cut about 2 mm. from the insertion (dotted line in fig. 3) while the assistant holds up the muscle with a hook. The sutures must be observed carefully to avoid injury to them. When the muscle is severed, the assistant grasps the cut distal end with a Graefe forceps and pulls the muscle toward the insertion until the new site of attachment is over the original insertion (fig. 4). The sutures are securely tied and the excess muscle trimmed. In this way the distal end of

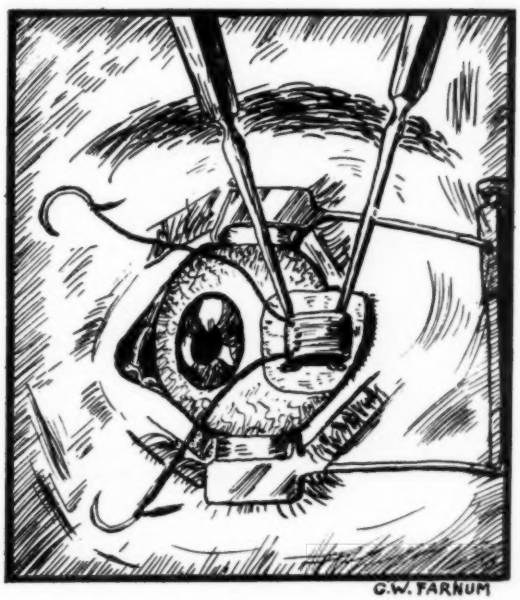

Fig. 2 (Yasuna). The suture is placed through the muscle insertion beneath, each arm of the suture being about 2 mm. from the muscle margin.

the muscle overlaps the insertion and places muscle over muscle which will result in a firmer union. The conjunctiva is closed with a continuous 6-0 black silk suture.

The above method is simple and the surgical field is never obscured with instruments. The amount of muscle to be resected is measured with the muscle in its normal anatomic position and no stretching is caused, as with the Prince forceps. When desired, larger resections have been possible with this method than with forceps. No vertical error is caused since the sutures are placed before the muscle is cut.

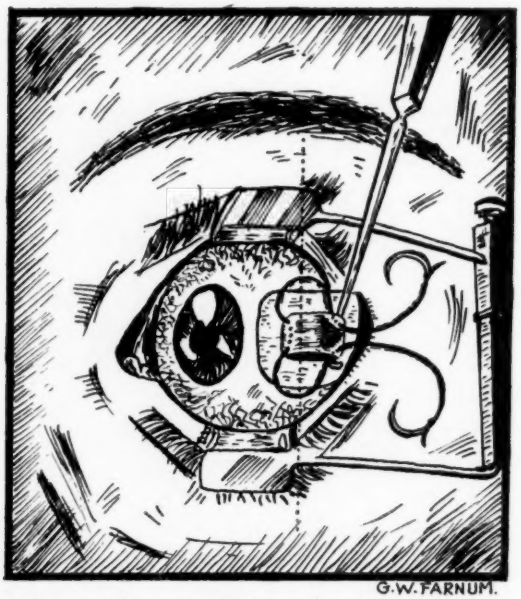

Fig. 3 (Yasuna). Each arm of the suture is placed through the muscle at the desired distance from the insertion, depending upon the amount of resection planned.

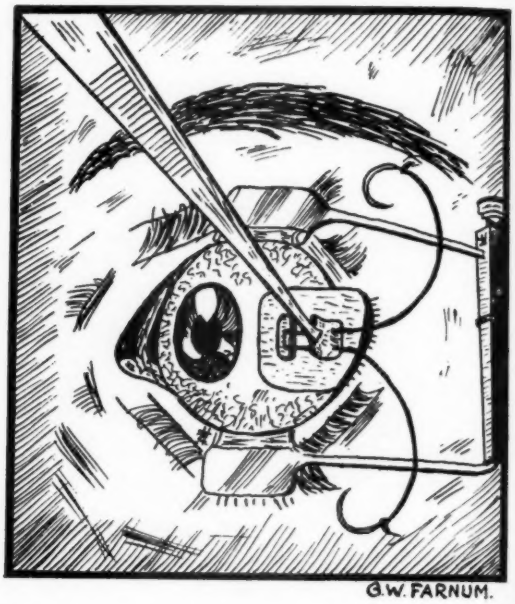

Fig. 4 (Yasuna). The severed muscle is pulled toward the insertion until the new site of attachment is over the original insertion.

The present standard textbooks on ophthalmic surgery[1, 2] do not describe a procedure for muscle resection without the use of forceps. On searching back among older ophthalmic surgical texts, however, a description is found in Török and Grout[3] of a resection method by Schweigger in which no forceps are used.

Conclusions

1. The use of resection forceps, such as the Prince, is not always secure, safe, and accurate. The instrument is awkward and obscures part of the surgical field.

2. A simple method of muscle resection without the use of forceps is described.

3. This method allows greater accuracy in determining the amount of resection, larger amounts of resection when necessary, and avoidance of vertical displacement.

44 Pearl Street.

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2. Spaeth: Principles and Practice of Ophthalmic Surgery. Philadelphia, Lea & Febiger, 1944.
3. Török and Grout: Surgery of the Eye. Philadelphia, Lea & Febiger, 1925, p. 423.

A MODIFICATION OF ELLIOT'S OPERATION AND ITS APPLICATION TO HIGH TREPHINATION

A PRELIMINARY REPORT

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Although Elliot's trephining operation is in general use and is much easier than the Lagrange operation, many surgeons prefer cyclodialysis or simple iridectomy because they sometimes encounter difficulties both in the technique of the operation itself and in the postoperative results.

DIFFICULTIES IN TECHNIQUE

As for the technique of Elliot's operation, two points cause certain difficulties. (1) It is sometimes difficult to separate the conjunctival flap beyond the margin of the cornea without tearing. (2) Trephination of the sclera requires the use of a sharp instrument, much training, and great caution if the ciliary body is not to be injured.

It occurred to me that the introduction of a metal plate between the sclera and the ciliary body, before the sclera is buttonholed, would greatly facilitate the performance of the operation. It would give a firm support to the trephine when the sclera is punctured; it would protect the deeper parts of the eye from trauma; it would permit the surgeon to use an exceedingly sharp trephine which makes for better end results. (According to Meller[1] when a dull or blunt trephine is used, the scleral wound generally overgrows.)

MODIFICATION OF OPERATION

With these difficulties in mind, I modified the operation in the following manner (fig. 1).

TECHNIQUE

The conjunctiva is incised with scissors 1 cm. above the superior limbus of the cornea and is then separated up to its margin. An incision of the sclera is made as for a superior cyclodialysis; that is, on the vertical meridian, 5 to 6 mm. from the limbus. The cyclodialysis spatula, or the iris repositor, is introduced between the sclera

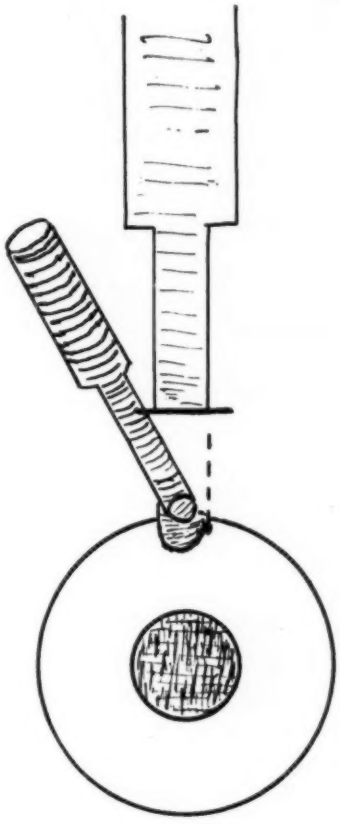

Fig. 1 (Arkin). A modification of Elliot's trephining operation.

and the ciliary body which is not broadly separated from the sclera. The spatula is left in place to act as a support for the trephine.

Holding the spatula in the left hand, I use the *right hand* to perform the trephination in the corneoscleral margin at the meridian,

as is customary, while the sclera is lifted by the spatula. (The end of the spatula is visible across the cornea.) To avoid any slipping of the trephine, a wider spatula (3 mm. in width) may be used, or the spatula and trephine can be combined into one instrument (fig. 2).

Combining the operations of cyclodialysis and trephination, even with the broader

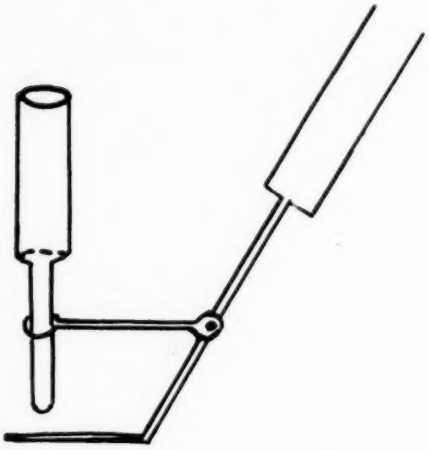

Fig. 2 (Arkin). The spatula and trephine can be combined into one instrument.

separation of the ciliary body, does not alter the final result. Cyclodialysis has for a long time been used with other operations for the relief of glaucoma in order to reinforce their action. No complications have resulted. Statistics show that, in cases of long standing, iridectomy is not effective in lowering the intraocular pressure but gives only temporary relief from an acute attack and that, in the end, a second operation (cyclodialysis) is indispensable.

Discussion

It would seem wise, therefore, to avoid two operations, when both procedures can be performed jointly. A majority of surgeons separate the ciliary body by means of a corneoscleral incision either before or after the iris is excised. Such a performance may be termed "cyclodialysis inferior" or "cyclodialysis superior," depending upon the technique used. I have come to the conclusion that it is much easier to execute the "cyclodialysis superior" first and then to perform a classical iridectomy immediately.

If cyclodialysis does not include a broad separation of the ciliary body, it does not cause an inflammatory reaction, and that is why it does not put an additional burden upon the eye if it is performed jointly with other operations for the relief of glaucoma. Indeed, cyclodialysis has one advantage in that it liberates the angle of filtration and thereby enables one to perform a correct trephination.

When the angle of filtration has trabecular and sclera-iris adhesions, the fact that the trephine on its way across the iris pricks through the iris tissue may be the reason that the aqueous does not leak away after the corneoscleral puncture is made.

When a trephination is performed as described, it is executed with greater safety because injury of the underlying tissues is impossible. The operator need not concentrate upon the sharpness of the trephine and, since there is support for the trephine, an even corneoscleral puncture can be made with a blunter instrument.

If a narrow spatula is used, the liquid flows out slowly, and the iris inserts itself on the sides. (It suffices then to withdraw the spatula and the iris prolapses only on removing the instrument.) It is important to remove the spatula slowly so that the liquid does not flow out too rapidly, causing dislocation of the lens or hemorrhage.

The chief disadvantage of this modification of Elliot's trephining operation is the possibility of a late infection being caused by the inclusion of corneal epithelium in the covering of the corneoscleral wound. Since the inferior part of the wound is only just covered with the corneal tissue which can easily be impaired, a secondary infection may follow. There is less danger of late infection after the Lagrange type of

operation because, when this procedure is used, the wound lies obliquely almost beyond the cornea.

Report of a case

While using a 2-mm. trephine to operate a case of glaucoma simplex, the instrument slid upward. Since it was too late to correct the instrument's position, I was compelled to finish the trephination with great care, striving not to injure the ciliary body.

In order to accomplish this, I maneuvered the upper part of the scleral disc close to the sclera and cut only the lower part with the trephine. When the instrument was taken away, I lifted the lower part of the disc with the forceps and cut away the upper part very carefully with the Graefe knife. Only when the spatula was introduced through the puncture in the anterior chamber did the aqueous flow.

As the spatula was introduced, I felt some resistance that indicated the presence of trabecular or scleral iris adhesions. Black tissue (the ciliary body) was visible in the superior portion of the wound and below the base of the iris which could be recognized by its different color. The iris did not prolapse because the wound lay almost totally on the ciliary body.

For fear of injuring the ciliary body, I did not try to draw out the iris but finished the operation and covered the wound with the customary conjunctival flap.

On the second postoperative day, the eye was quiet, and there were no signs of inflammation. There was good filtration and the intraocular pressure was reduced. Postoperative progress was normal, intraocular pressure became lower, and filtration persisted.

Comment

An analysis of this case made me conclude that performing a trephination in this manner (it could be named *superior trephination*) has some advantages. (1) The wound is covered completely with conjunctiva which facilitates separation of the flap from the corneal epithelium. Since the conjunctival flap is thicker, it is seldom perforated which is a certain safeguard against secondary infection. (2) Conjunctiva, more easily permeated by aqueous than corneal epithelium, completely covers the wound—not just half of it, as in the original Elliot's trephining operation. (3) When this modified method is used, the iris does not prolapse and obstruct the wound. Since the wound is bounded by the ciliary body, an iridectomy can be avoided. This latter circumstance necessitates an explanation.

Discussion

In executing the Elliot trephining operation in the traditional manner, it is almost always necessary to perform an iridectomy because the iris either prolapses or obstructs the wound. Because of the pressure of aqueous from behind, it is almost impossible to replace the iris since it is too frail to hold back this pressure.

The question may well be asked if iridectomy is not essential to the relief of high intraocular pressure. It would seem that the existence of free filtration is sufficient to reduce the pressure. I have found that a high ocular tension resulting from iritis (iritis glaucomatosa) can be controlled more quickly by trephination without iridectomy.

Since this technique is confined to sclerectomy, not only the iris, but the entire eye, is protected from injury, and the possibility of obstructing the wound with remnants of excised iris is eliminated.

One disadvantage of this technique lies in the possibility of injuring the ciliary body. For this reason, the modification in technique herein described is best suited to high trephination. This protects the ciliary body from damage and, at the same time, produces separation of trabecular adhesions.

Any fear that the ciliary body will fill

the wound may be dismissed. Even when a 2-mm. trephine is used, the ciliary body is too thick to obstruct the wound. Such a complication usually occurs after iridectomy or sclerectomy in which the wound is wider.

On the other hand, the iris is so delicate that its fold can obstruct even such a small incision as a buttonhole of the sclera. The higher in the sclera the incision is made, the less is the possibility of the iris prolapsing. However, it is important not to make an incision too high in the sclera for then the ciliary body would obstruct the wound completely and there would be no free filtration of aqueous.

In order to guarantee free filtration, a certain portion of the wound should be unobstructed and should open either directly into the chamber or, at least, touch its border.

In a survey of the available literature I found a paper by Schultz[2] with a discussion by Schieck. Assuming that a wound covered only with conjunctiva protects the eye against infection, Schultz used high trephination. In his discussion, Schieck said that high trephination injured the ciliary body and maintained that great caution was necessary to avoid this complication.

My method by which a spatula is used as a safeguard against the possibility of injuring the ciliary body would seem to be an answer to this criticism.

Summary*

1. A new method of trephination is described. It consists of introducing a spatula between the sclera and ciliary body as for cyclodialysis. The protection of the metal plate makes trephination easier and safer.

2. Cyclodialysis without great separation of the ciliary body does not detract from the end results, but on the contrary has certain advantages.

3. The so-called "superior trephination" has advantages over the classical or "inferior trephination." It is only considered more dangerous because there is fear that the ciliary body may be injured. This seldom occurs.

4. The use of a spatula between the sclera and ciliary body as protection in high trephination eliminates the possibility of injuring the ciliary body.

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* This paper must be regarded as a preliminary report, since all my notes and case records were destroyed during the war.

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A NOTE ON METHODOLOGICAL EVALUATION OF SELECTED VISUAL TESTS*

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INTRODUCTION

In evaluating any method from the point of view of its usefulness in laboratory investigations on man one should ask at least three questions: (1) Is it affected by practice? (2) Does it yield, on successive applications, consistent results? (3) Is it sensitive to the experimental variables the effect of which it is used to test?

Too frequently the first two questions are neglected or decided impressionistically. Yet there is little doubt that the quantitative and impersonal approach should not stop at the stage of obtaining raw measurements but should be carried into the stage of evaluation as well. In the present paper we shall discuss from this standpoint a number of visual functions measured in connection with investigations on the effect of illumination on performance and fatigue. The work task, experimental design of the series, and the statistical concepts and computational formulas were presented in detail elsewhere.[1, 2] The reader may refer especially to a paper on ophthalmological functions, published in the JOURNAL,[3] for a more detailed discussion of the fundamental issues and statistical methodology.

SUBJECTS

The subjects were six young men with normal vision and ocular structures who participated in nutritional studies carried out at the laboratory during the year preceding the visual investigations. They were coöperative and conscientious, and were well adapted to experimental work.

* From the Laboratory of Physiological Hygiene, University of Minnesota. This work was supported in part by a grant from the Verd-A-Ray Corporation, Toledo, Ohio.

METHODS

The following functions will be discussed in this paper: recognition time for threshold stimuli, brightness discrimination, flicker fusion frequency, and blinking rate. The first three functions were measured before and after two hours of standardized visual work which reproduced, in a miniature job situation, the operation of conveyor inspection.[1] The blinking rate was determined during the course of visual work. These functions were a part of a large battery of tests applied in our studies on the effect of illumination intensity[4] and the spectral quality of light.[5]

RECOGNITION TIME FOR STIMULI OF THRESHOLD SIZE

The test of visual acuity consisted in designating the location of dots in white squares, 1.5 by 2.5 inches. The stimuli of different size were presented in random order. The distance between the test patch and the subject was kept at 18 feet, and the illumination remained constant. The time from the moment the stimulus was presented to the instant of recognition was determined. The recognition time for the smallest dot which was correctly located was taken as the test score.

BRIGHTNESS DISCRIMINATION

One half of the visual field in the Pulfrich photometer manufactured by Zeiss was set at a brightness level which served as a standard throughout the experimental series. The brightness level in the other half of the visual field was set at zero (darkness) and the subjects' task was to increase the brightness until it matched the standard. The deviation, expressed in arbitrary units, above or

below the correct value, served as a score. Both a red and a green filter were used. The score for each testing is based on five repeated determinations made with each filter.

Flicker fusion frequency

The flicker was produced by interrupting a beam of light by means of a rotating, perforated disc. The opening in the opal glass on which the light fell was about 1 cm. in diameter, with the distance from the light stimulus from the eyes fixed at 40 cm. The number of flickers per second was increased at a standard rate from a coarse flicker to the point of an apparent fusion. Three successive measurements were made at each testing and averaged.

Blinking rate

The blinking rate was determined by counting the number of blinks for five minutes. The count was taken at the start, at the midpoint, and toward the end of a 2-hour work period. Both the initial reading and the average value were considered, expressed as the number of blinks per minute.

Effects of practice

In experiments requiring testing repeated over a period of days (or months, as is the case in nutritional studies) it is desirable to reach a stable performance plateau before the start of the experimental work. The information on changes resulting simply for a repeated administration of a test and due to the complex of factors summed up in the term "practice" is essential for the planning of experimental work yet the data on this point are scarce. The initial test scores obtained under standard conditions before or at the start of the work test on the first 6 testing days, separated by 2 or 3 days during which the subjects worked as clerical or technical assistants in the laboratory, provide a useful material for a study on the effects of practice.

The men were well acquainted with the experimental procedures and were tested twice before the start of the experimental work proper. On inspection there was little change in the scores obtained on these two occasions. On the basis of theoretical considerations, as well as previous experience with some of the tests used in this series, no marked practice changes were expected. The presence of practice trends was tested by comparing the mean of the different functions for the first 3 testing sessions with the mean of the 4th, 5th, and 6th testing sessions. The data (table 1) indicate that the actual mean changes were small and reached the 5-percent level of statistical significance only in the case of flicker fusion frequency. This was somewhat surprising, since in our previous work no statistically significant effects of practice were observed when a group of 8 men was tested on 15 consecutive days.[6] Simonson and others found little change in the fusion level in 11 subjects who were tested repeatedly at least once a week up to 13 weeks.[7]

Probably the main factor which produced the apparent lowering of the fusion level in the present series was a better coördination of the perception of fusion by the subject and giving the signal to the experimenter, thus shortening the lag between occurrence of the fusion and reading of the dial. The second factor of potential importance in long-term experiments is the possible change in the criterion of "fusion." These factors are minimized if separate, repeated trials are made with definite rates of flicker. As indicated above, in this series the readings were made during the ascending, automatically increasing rate of flicker. However, the alternative procedure is more time consuming.

The actual "practice" change in the average flicker fusion-frequency score was small. In terms of the "fitness," the change was in the biologic direction of "deterioration": the higher the fusion score, the greater the capacity of the retinocortical system to perceive successive flashes as discrete stimuli and, therefore, by definition, the "better"

TABLE 1

THE DIFFERENCES BETWEEN THE MEAN SCORES AND THE F-TESTS OF THEIR STATISTICAL SIGNIFICANCE FOR THE FIRST AND SECOND SET OF THREE SUCCESSIVE TESTING SESSIONS

Function	Units	Mean Differences	Biological Direction of Change†	F-Values
Recognition time	sec.	−1.2	+	0.94
Brightness discrim., red	arbitrary	+0.1	(−)	0.41
Brightness discrim., green	arbitrary	−0.4	+	2.09
Flicker fusion frequency	flickers per second	−0.6	−	6.39*
Blinking rate, initial	blinks per minute	−1.6	+	1.78
Blinking rate, average	blinks per minute	−1.2	+	0.10

* For 1 and (18−1) = 17 degrees of freedom, the value of the F ratio at the 5% level of significance is 4.45, at 1% level it is 8.40.

† The plus sign indicates an "improvement," the minus sign a "deterioration."

the score. In the majority of the other functions, the changes were in the direction of "improvement" but remained well within the limits of chance variation.

CONSISTENCY OF REPEATED MEASUREMENTS

The data analyzed from the point of view of the consistency of the measurements were obtained in the 13th to 18th session of the series. The rows in Table 2 represent data obtained for each individual in the course of six testing sessions, separated by 2 to 3 days; the arithmetical averages of the rows indicate *individual means.* The columns represent testing sessions; averages of the columns may be referred to as *"daily means."*

TABLE 2

MEASUREMENTS OBTAINED IN A SERIES OF SIX REPEATED TESTING SESSIONS

A. Recognition Time

	Trial 1	2	3	4	5	6	$\bar{Y}_I$
H	4.0	1.5	1.5	4.0	3.5	2.0	2.8
R	4.0	7.0	2.5	10.0	6.5	14.0	7.3
O	13.0	6.0	13.0	6.0	17.0	7.0	10.3
P	6.0	3.0	9.5	7.0	7.5	7.0	6.7
B	5.0	8.0	4.0	2.5	2.5	6.0	4.5
V	3.5	3.0	1.5	2.0	6.5	2.0	3.1
$\bar{Y}_D$	5.9	4.8	5.3	5.2	7.2	6.2	

B. Brightness Discrimination (Red)

	Trial 1	2	3	4	5	6	$\bar{Y}_I$
H	1.4	1.2	1.3	1.3	1.7	2.4	1.6
R	2.2	2.8	1.8	2.2	2.1	2.6	2.3
O	4.6	4.1	3.3	4.0	4.2	3.2	3.9
P	3.1	3.5	2.0	3.3	3.6	2.7	3.0
B	2.3	2.5	2.6	2.7	2.3	2.2	2.4
V	2.7	2.4	2.5	2.2	2.0	2.8	2.4
$\bar{Y}_D$	2.7	2.8	2.2	2.6	2.6	2.6	

C. Brightness Discrimination (Green)

	Trial 1	2	3	4	5	6	$\bar{Y}_I$
H	2.1	2.4	1.6	2.1	1.9	3.0	2.2
R	2.4	2.5	2.3	3.0	1.9	2.1	2.4
O	3.6	3.1	2.8	3.0	2.9	3.1	3.1
P	3.1	3.4	2.7	3.2	3.1	2.8	3.0
B	2.4	2.9	2.7	2.4	2.5	2.8	2.6
V	2.6	3.1	2.8	2.9	2.6	2.9	2.8
$\bar{Y}_D$	2.7	2.9	2.5	2.8	2.5	2.8	

D. Flicker Fusion Frequency

	Trial 1	2	3	4	5	6	$\bar{Y}_I$
H	47.2	47.8	48.4	46.5	46.2	48.5	47.4
R	46.1	44.4	46.0	46.8	46.9	44.0	45.7
O	45.5	43.4	45.5	45.8	43.7	44.9	44.8
P	45.6	45.1	45.6	44.3	45.3	44.6	45.1
B	45.1	46.4	48.0	47.6	46.5	44.3	46.3
V	47.1	46.6	46.5	47.3	46.4	46.6	46.8
$\bar{Y}_D$	46.1	45.6	46.7	46.4	45.8	45.5	

E. Blinking Rate, Average

	Trial 1	2	3	4	5	6	$\bar{Y}_I$
H	8.9	8.8	10.8	10.8	9.3	9.1	9.6
R	2.6	2.8	2.8	2.3	2.9	3.8	2.9
O	3.0	3.8	3.8	3.8	3.0	3.3	3.4
P	8.0	6.0	12.1	9.6	7.0	9.1	8.6
B	7.6	8.3	5.9	5.7	5.2	4.3	6.2
V	5.0	4.0	5.7	3.0	4.2	2.7	4.1
$\bar{Y}_D$	5.8	5.6	6.8	5.9	5.3	5.4	

F. Blinking Rate, Initial

	Trial 1	2	3	4	5	6	$\bar{Y}_I$
H	7.0	9.0	10.7	8.7	7.3	7.0	8.3
R	3.3	3.0	2.0	2.3	3.7	6.7	3.3
O	3.0	3.0	5.0	3.0	2.0	4.3	3.4
P	3.3	3.7	13.3	7.3	8.7	10.0	7.7
B	5.0	8.3	5.3	6.7	3.3	4.0	5.4
V	5.3	4.7	4.7	2.3	5.0	2.7	4.1
$\bar{Y}_D$	4.5	5.3	6.8	5.0	5.0	5.6	

In a 2-way table we may compute three types of variation, characterized statistically in terms of variances:

1. Variation within the rows; this may be designated as "variance within individuals," V_{wI}.

2. Variation within the columns, expressed as "variance within days," V_{wD}.

3. The discrepancy between the scores predicted on the basis of the mean values for a given individual and a given day, and the actual measurements; this type of variability is expressed as the "random variance," V_R.

When there are no significant trends in the scores obtained in consecutive testing trials and when the ratio V_{wI}/V_R approaches one, the consistency of a test may be characterized in terms of the *intraindividual* variation (V_{wI}). This indicates the amount of inconsistency in the scores obtained on different days under standard conditions. In evaluating the magnitude of this "experimental error" we shall compare it with the *interindividual* variation (variance within days, V_{wD}). Ideally, we should know the population value of this characteristic; when we are working with small samples of highly homogeneous subjects, the V_{wD} is likely to be a gross underestimate of the population value. The comparison of V_R and V_{wI} with V_{wD} can be obtained in the form of a simple percentage

$$\left(\%\ V_R = \frac{100V_R}{V_{wD}}, \quad \%\ V_{wI} = \frac{100V_{wI}}{V_{wD}}\right)$$

or in a form of a coefficient of day-to-day consistency

$$\left(r_C = 1 - \frac{V_R}{V_{wD}}, \quad r'_C = 1 - \frac{V_{wI}}{V_{wD}}\right).$$

TABLE 3

STATISTICAL DATA CHARACTERIZING THE CONSISTENCY OF REPEATED MEASUREMENTS OF SELECTED VISUAL FUNCTIONS

Function	Mean Score	Variances			
		V_R	V_{wI}	V_{wD}	V_{wI}/V_R
Recognition time	5.8 sec.	9.6	8.7	16.4	0.91
Brightness discrim., red	2.6 units	0.18	0.19	0.78	1.06
Brightness discrim., green	2.7 units	0.09	0.10	0.20	1.11
Flicker fusion frequency	46.0 flickers	0.9	1.0	1.8	1.11
Blinking rate, initial	5.4 blinks	4.2	4.1	8.2	0.98
Blinking rate, average	5.8 blinks	1.5	1.6	9.2	1.07

Function	$\frac{100V_R}{V_{wD}}$	$1-\frac{V_R}{V_{wD}}$	$\frac{100V_{wI}}{V_{wD}}$	$1-\frac{V_{wI}}{V_{wD}}$
Recognition time	59%	0.41	53%	0.47
Brightness discrim., red	23%	0.77	24%	0.76
Brightness discrim., green	42%	0.58	50%	0.50
Flicker fusion frequency	50%	0.50	56%	0.44
Blinking rate, initial	51%	0.49	50%	0.50
Blinking rate, average	16%	0.84	17%	0.83

As indicated in Table 3, the average intra-individual (V_{wI}) and the random (V_R) variance are of about the same magnitude, their ratio being for all the visual functions tested very close to 1.00; consequently, both can serve as an indicator of the "chance variation" in scores obtained on repeated testing. When we express the "error variances" (V_R and V_{wI}) as percentage of the average interindividual variance (variance "within days," V_{wD}), the figures run from 16 percent for the blinking rate average to 59 percent for the recognition time, and the coefficients of consistency range from 0.84 to 0.41. In view of the high homogeneity of the sample, we may be certain that the average interindividual variance (V_{wD}) used as the criterion for the evaluation of the "ex-

perimental error" is too small and, consequently, the tests appear to have low consistency. Elsewhere[2] tentative limits for the evaluation of consistency coefficients have been set as follows: for very high consistency $0.91 \leqq r_C \leqq 1.00$, for high consistency $0.81 \leqq r_C \leqq 0.90$, and for low consistency $r_C \leqq 0.70$.

We have an empirical check on the effects of the homogeneity of the sample for the flicker fusion frequency, which was tested by the same instrument in a larger group of subjects; both groups were drawn from the same population. For the larger sample ($N = 36$) the interindividual variance was 19.40. Using this as an estimate of the population value, the percentage error ($100\ V_{wI}/V_{wD}$) is reduced from 56 percent to 5.2 percent, and the coefficient of consistency increases from 0.44 to 0.948 which is a very respectable figure. This value is close to the product-moment correlation of 0.981 obtained by correlating two sets of flicker fusion determinations made a week apart on the 36 men in the age range from 20 to 30 years.

For the other functions no such correction can be made because values for larger samples are not available but one may be certain that the consistency of the tests which at present appear low and in some cases very low would improve markedly if adequate estimates of the interindividual variability were available.

Sensitivity to stress

No attempt will be made to investigate this question systematically. The type of stress will be limited to visual work and the data will serve only as an illustrative example. The visual work used as the experimental "stress" involved recognition of moving letters, exposed for a fraction of a second, and has been described in detail.[1] The set of experiments considered in this context involved 2 hours of work at the illuminative level of 5 foot-candles. This represented a fairly severe strain and should be a reasonable criterion for testing the possible use of these functions for laboratory studies of visual fatigue.

TABLE 4

CHANGES IN THE VISUAL FUNCTIONS TESTED BEFORE AND AFTER TWO HOURS OF VISUAL WORK INVOLVING RECOGNITION OF LETTERS (VISUAL ANGLE OF TEN MINUTES) AT FIVE FOOT-CANDLES

Function	Mean Differences	F-Values	Biologic Direction of the Change†
Recognition time	+3.7 sec.	16.55*	−
Brightness discrim., red	+0.2 units	2.69	−
Brightness discrim., green	−0.05 units	0.15	+
Flicker fusion frequency	−0.9 flickers per sec.	18.33*	−
Blinking rate (initial-terminal)	+0.8 blinks per min.	1.01	−

* For 1 and $(36-1)=35$ degrees of freedom, $F_{0.05}=7.42$, $F_{0.01}=4.12$.
† The plus sign indicates an "improvement," and the minus sign a "deterioration."

The differences between the mean values of 36 individual determinations made before and after the 2-hour spell of intensive work or, in the case of the blinking rate, at the start and end of the visual work, are given in Table 4.

The change was in 4 out of 5 functions in the direction of deterioration but only the recognition time and the fusion frequency of flicker were affected significantly. In terms of biologic significance, as distinguished from statistical significance, the change in the flicker fusion frequency was small. The increase in the recognition time attained a value which would be relevant from the practical point of view.

The different behavior of the functions measured may in part reflect a true

differential sensitivity, in part it may be due to the fact that the determinations of brightness discrimination were made last in the series of tests with a delay of about 15 minutes as compared with the determinations of the recognition time and flicker fusion frequency which were measured immediately at the end of the work.

The change in the rate of blinking at intervals measured during work is not sensitive to the visual stress and can not serve as an "index of fatigue." This is in conformity with the experience of Tinker and other investigators (see ref. 8, esp. p. 440 ff.).

Summary and Conclusions

1. An attempt was made to evaluate a number of visual characteristics from the point of their usefulness in laboratory investigations of "fitness" and "fatigue."

2. The functions studied included recognition time for threshold stimuli, brightness discrimination, flicker fusion frequency, and blinking rate.

3. As a result of practice in taking the tests, there was a small but statistically significant drop in the fusion frequency of flicker. The decrease in the rate of blinking and in the amount of error made in matching a standard level of brightness (green filter) was not significant.

4. The consistency of the scores repeated on six different occasions under standard conditions appears to be low, due to a very high homogeneity of the sample. When, in the case of the fusion frequency of flicker, more valid estimates of the interindividual variation for the population were substituted for the estimates obtained on the given sample of subjects, the consistency criteria assumed satisfactory values.

5. When the functions were measured before and after 2 hours of strenuous visual work under 5 foot-candles, the difference between initial and terminal scores was in direction of biologic deterioration in all of the functions studied, except the brightness discrimination (green filter). The change was statistically significant only in the case of the recognition time and the flicker fusion frequency.

Stadium South Tower (14).

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SOME EXPERIMENTS WITH GREEN SPECTACLES PRESCRIBED TO GLAUCOMATOUS PATIENTS*

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In our preceding work† it was shown that the illumination of the one eye with green light resulted in the lowering of the intraocular pressure in the other eye, this effect being especially pronounced in glaucomatous eyes. It seemed natural, therefore, to test the use of green spectacles, as a means tending to reduce intraocular pressure. The present paper contains a description of the attempts made by us in this direction.

Experiments involving the use of green spectacles by glaucomatous patients were carried out on 19 subjects with various forms of the disease.

The period of observation was 12 to 15 days for in-patients (11 cases), and 30, 50, and more days for out-patients (8 cases).

Method

The pressure was determined with the aid of the Schiøtz tonometer three times a day: at 7 a.m. when the patients were still in bed; at 1 p.m., and between 7 and 8 p.m., at the moments of a maximum or minimum intraocular pressure..

The patients were withheld from any medication during a whole day, or even two days, if the status of their eyes made it permissible. By the end of the second day, in most cases, the patient received green spectacles which he was asked to wear throughout the period of examination.

The spectacles were manufactured from green glass of a hue corresponding 511 mμ and with daylight transparency equal to about 21 percent.

In certain cases the use of green spectacles was combined with a greatly reduced dose of pilocarpine. The combination of green glasses with the instillation of several drops of adrenalin (1:1,000) was also made to test Kravkov's statement that the instillation of adrenalin at this concentration may increase the eye's sensitivity to the green light.

The effect of the use of green spectacles under the given conditions was evaluated by us from the run of the diurnal curve of intraocular pressure.

Results

From an analysis of the curves obtained from testing patients, it may be seen that, notwithstanding the total suspension of pilocarpine medication, the intraocular pressure showed a pronounced tendency to decrease in patients wearing green spectacles; the range of fluctuations of intraocular pressure during the day was likewise found to decrease. (Degenerative alterations of these eyes were not advanced, nor was the level of tension excessively high.)

An appreciable effect was obtained when the use of green spectacles was combined with the administration of a very small dose of pilocarpine (0.5-percent solution twice a day).

In 20 of 25 diurnal curves, we were able to observe a clearly expressed decrease in intraocular pressure, as well as a reduction of the range in fluctuation, as compared to the records taken at the period when the administration of pilocarpine was entirely suspended. The decrease in tension was a fairly appreciable one—6.0 mm. Hg in 8 cases; 6.0 to 10 mm. Hg in 9 cases; 10 mm. Hg and more in 3 cases.

The decrease in intraocular pressure was much more striking, however, in certain

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* From the Laboratory of Physiological Optics of the Helmholtz Central Ophthalmological Institute. Head of the laboratory, Prof. S. V. Kravkov; director of the Institute, Prof. A. A. Kolen.

† Am. J. Ophth., 31:721 (June) 1948.

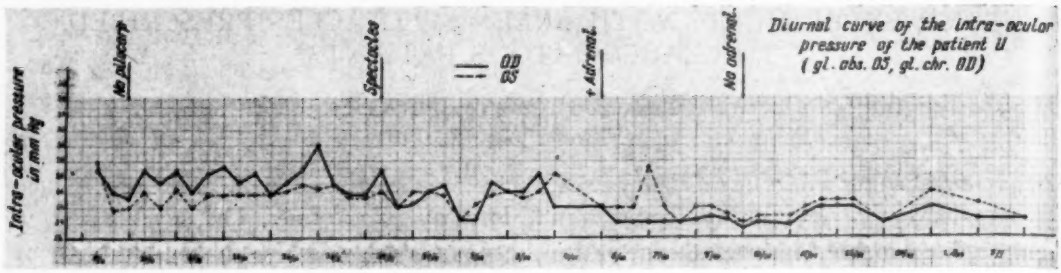

Fig. 1 (Zaretskaya). *Case 1.* Absolute glaucoma of the left eye; chronic glaucoma of the right eye.

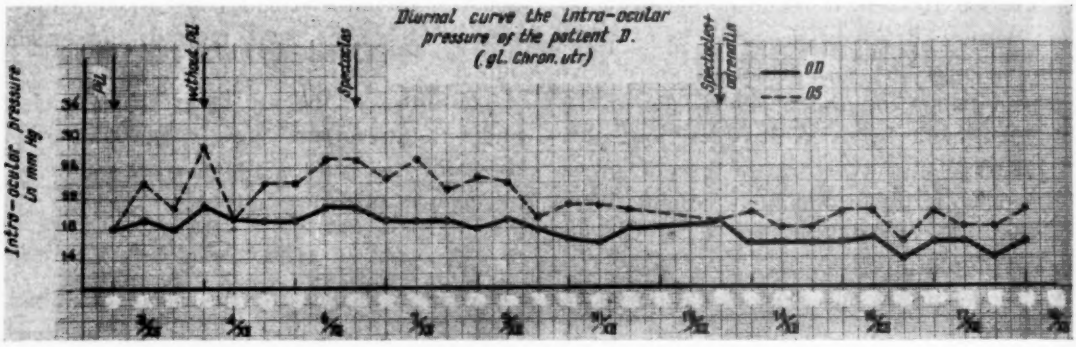

Fig. 2 (Zaretskaya). *Case 2.* Chronic glaucoma of both eyes.

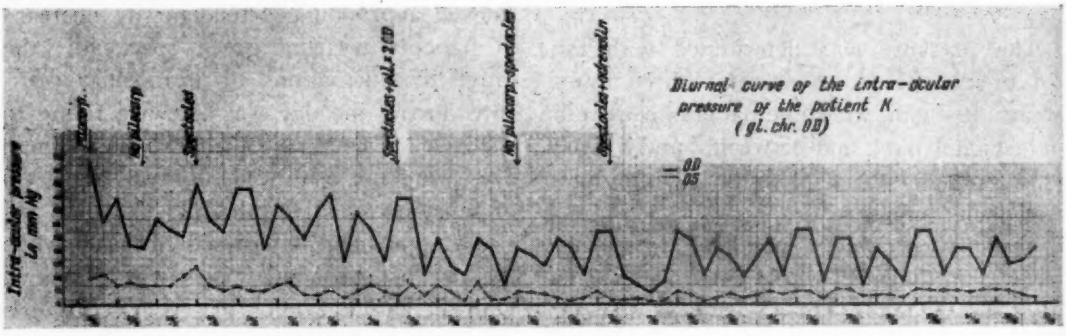

Fig. 3 (Zaretskaya). *Case 3.* Chronic inflammatory glaucoma of the right eye. The left eye was normal.

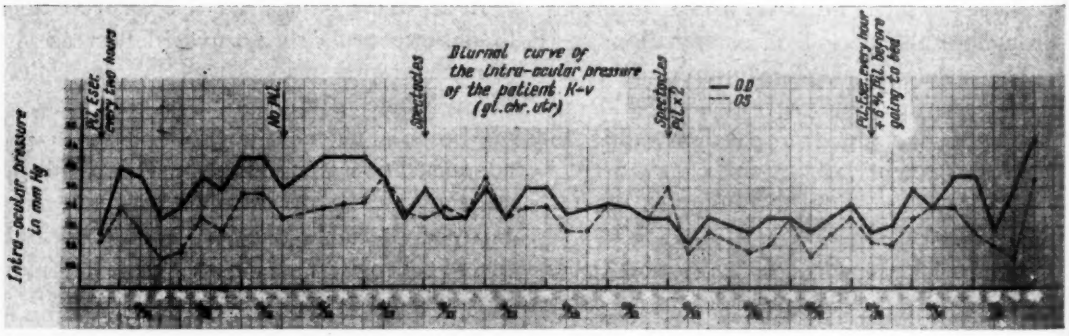
Diurnal curve of the intra-ocular pressure of the patient K-v (gl. chr. utr)
Intra-ocular pressure in mm Hg
Pil. 1 drop every two hours
No Pil.
Spectacles
Spectacles Pil. x 2
Pil. 1 drop every hour + 3 % Pil. before going to bed
OD
OS

Fig. 4 (Zaretskaya). *Case 4.* Chronic glaucoma of both eyes.

cases in which the use of green spectacles was combined with small doses of adrenalin.

The 24-hour curves reproduced in Figures 1 to 4 were plotted for some of the patients investigated by us and may well illustrate all that has been said.

Report of cases

Case 1 (fig. 1). The patient, a woman, 75 years of age, suffered from chronic glaucoma of the right eye and nearly absolute glaucoma of the left eye.

The eyes were quiet, corneas transparent, and the pupils were the size of a pinhead. The crystalline lens was sclerotic. Visual acuity of the right eye was 0.9; that of the left eye, light projection irregular. The visual field of the right eye showed a concentric contraction for the white, and a sharp contraction for the other colors. The fundus of the right eye showed a deep glaucomatous excavation of the papilla of the optic nerve; this was somewhat less profound in the left eye.

The tension as measured according to Sobansky in the arterial center of the retinas of the two eyes was 45 mm. Hg.

The patient has now been wearing her green spectacles for more than a year without receiving any supplementary medication.

No undesirable phenomena on the part of the patient's eyes have been recorded within this period during which she was under our continuous observation.

Case 2 (fig. 2). The patient, a man, aged 61 years, had chronic glaucoma of both eyes. He complained of a mist swimming before the eyes, iridescent halos when looking at the lamp, reduced visual acuity, but no pain. He had been treated since 1937 with instillation of 1-percent pilocarpine solution, without feeling any better. At the first examination, the patient was much annoyed by the continuous dimness in both eyes.

The pupils were extremely narrow (miosis medicam). Visual acuity was: R.E., 0.4 to 0.5, with a 0.5D. sph., 1.0; L.E., 0.4, with a 0.75D. sph., 1.0.

Green spectacles were prescribed and, as may be seen from Figure 2, the general level of the diurnal curve of tension for both eyes became lower. The patient enjoys his spectacles and feels more comfortable.

However, since the intraocular pressure in the left eye was occasionally found to fluctuate above the normal level, an attempt was made to combine the use of green spectacles with instillation of adrenalin solution (1:1,000). As seen from Figure 2, both the level of tension and its fluctuation range soon became quite normal.

Case 3 (fig. 3). Patient K, a man, 62 years old, had chronic inflammatory glaucoma of the right eye. The left eye was normal. He had been ill since 1938 when he suddenly became aware of reduced visual acuity, of iridescent halos, and mist before his right eye.

Visual acuity was O.U., 0.02, without correction; O.U., 1.0, with correction.

The fundus of the right eye showed a glaucomatous excavation of the papilla of the optic nerve, although not sharply pronounced. The papilla was hyperemic, the veins extended.

The visual field was somewhat concentrically restricted for the white, and somewhat more for colored lights. The left eye was within the normal.

On November 29th the patient was asked to wear green spectacles. Diurnal curves were analyzed for five days. During this period, the intraocular pressure persistently showed a wide range of fluctuation, although at a somewhat lower level. The patient felt well, and he was less annoyed by the feeling of mist swimming before his eyes. He liked to wear his spectacles which make him feel more at rest; he was becoming much less irritable.

On December 6th, a 1-percent pilocarpine solution was prescribed in addition to the

use of green glasses. This was to be instilled twice a day into his right eye.

Under these conditions intraocular pressure showed a marked decrease, although on separate days of the period of examination its level attained 44 mm. Hg.

The best effect was attained, however, by substituting a 1:1,000 solution of adrenalin, twice a day, for the pilocarpine. The patient was observed for 11 days. Without entirely normalizing the tension, the combination of green spectacles with adrenalin prevented the maximum tension from exceeding 34 mm. during these days.

It should be pointed out in this place that, during the course of our experiment, we often observed that the instillation of pilocarpine at shorter intervals caused the intraocular pressure to persist at a higher level than when less frequent doses, or no pilocarpine at all, were given.

Case 4. (fig. 4). At this juncture it is of interest to cite the case of Ku., aged 65 years, who suffered from chronic glaucoma of the two eyes. The diurnal curve of this patient, after he had refused to wear green spectacles combined with small doses of pilocarpine, and after pilocarpine and eserine every hour had been prescribed as a preoperational treatment, shows that there was a sharp increase in tension and that the level, in general, was much higher than during the preceding days. The range of fluctuation of tension, which had been 6.0 mm. or less, rose to 10 to 16 mm. during these days.

Comment

In addition to these successful results, cases were also encountered where the patients derived no benefit whatever from the use of green spectacles. Some even showed a slight increase in intraocular pressure, although this increase was observed in individual cases only, in patients whose intraocular pressure had for the most part been stabilized at a high level.

The questions arise: What is the clinical value of our investigations? And what is their practical application?

The encouraging results of our experiments make us believe that the use of green spectacles may, in certain forms of glaucoma, prove a helpful therapeutic procedure, especially if prescribed along with small doses of adrenalin or pilocarpine.

Discussion

The mechanism of the action of indirect stimuli upon the intraocular pressure is rather obscure and so is, although to a lesser degree, the mechanism responsible for the appearance of hypertension in the case of glaucoma.

Unquestionable, however, is the fact that green light, while acting upon the color receptor of our vision, produces a definite rearrangement in the vegetative nervous system, thus affecting also the neurovascular apparatus of the eye.

It may be assumed that the amounts of acetylcholine and sympathin in the eye are different, according to whether the eye is exposed to green or to red light: this may possibly be the cause of the opposite reaction of the intraocular pressure for the red or the green stimulus revealed by us.*

Conclusions

1. Preliminary tests have shown that the use of green spectacles prescribed along with a total withdrawal of pilocarpine medication produces in glaucomatous patients a well-pronounced tendency toward a decrease in their intraocular pressure. The beneficial effect observed was at its maximum in patients showing a medium level of intraocular pressure accompanied with no sharply expressed disturbances in the function of the sight.

2. The intraocular pressure in glaucomatous patients has been found to be most reduced when the use of green spectacles

* Am. J. Ophth. 31:721-727 (June) 1948.

was reinforced by the administration of small doses of adrenalin.

3. The mechanism of action of the green-light stimulus upon intraocular pressure still remains obscure. It is very probable however, that by acting upon the color receptor of the human eye, the green light brings about a definite rearrangement in the autonomous nervous system and thus affects the neurovascular apparatus of the eye.

Sadovaya-Chernogryazskaya Street. (14/19).

RUBEOSIS IRIDIS DIABETICA

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New York

The association of new capillary formation on the iris with glaucoma in diabetic patients was first noticed by Salus[1] in 1928. He proposed the term rubeosis irides diabetica and called the associated glaucoma the true diabetic glaucoma in contradistinction to the usual primary glaucoma in the ordinary diabetic patient. Since his report of 3 cases, 37 more cases have appeared in the literature and have been reviewed by Fralick.[2] Two of the 5 cases reported by Fralick occurred in the absence of diabetes. The rarity of this condition is indicated in its absence in a series of 2002 diabetics in whom rubeosis was searched for, studied by Waite and others.[3]

The original description of Salus and his conclusions have been somewhat modified by the report of subsequent cases. As originally described, the surface of the iris is transformed by the appearance of new, light-red, capillary nets superimposed on an otherwise normal appearing iris tissue. These new vessels are in the region of the lesser circle of the iris, placed closely together and interlinked, and give this portion of the iris a reddish hue.

Other larger vessels run radially from the lesser circle toward the ciliary part where they disappear in the angle of the anterior chamber. The vessels never extend into the pupillary area itself.

The rubeosis is not related to the severity nor to the duration of the diabetes. Kurz[4] presents one case in a man, aged 29 years, with diabetes of only three years' duration. The rapidity with which glaucoma follows the rubeosis is quite variable and may appear concomitantly or may be delayed as long as five years, as in one case of Salus. One third of the cases have an associated essential hypertension. Hemorrhagic and proliferating retinopathy is frequently associated.

Wegner[5] reports one case of rubeosis associated with diabetic retinopathy that was successfully operated on for cataract by intracapsular extraction. In view of the inevitable glaucoma in all other cases and the interval of five years between the appearance of rubeosis and the glaucoma in the case of Salus, the cataract extraction was probably followed by glaucoma after a long interval.

Glaucoma is a sequel to the capillary formation and invariably appears if the cases are followed long enough. The glaucoma is associated with hemorrhage in the anterior chamber and does not respond to miotics; surgical intervention is always followed by disastrous consequences.

Gonioscopic examination of the angle was described by Kurz[4] who found large radially running vessels breaking up into many branches connecting directly with Schlemm's canal. The angle at first was bridged by numerous synechias between which ran many fine vessels; the angle was almost completely obliterated as the pathologic process advanced. Schlemm's canal was filled with

blood on gonioscopic examination. The histologic examination by Kurz revealed that the new vessels were not associated with inflammation and were not part of a new membrane but lay in and upon iris tissue itself.

These eyes respond not at all to treatment and because of the pain may have to be enucleated. In the stage of absolute glaucoma, the neocapillary formation disappears from view as the iris stroma undergoes atrophy and no evidence of the antecedent rubeosis is present. Kurz presents this fact as evidence that the new vessel formation is not part of an inflammatory membrane but part of the iris tissue and shares its fate when it atrophies. The characteristics of the associated glaucoma is that it is of the hemorrhagic type. There is always a deep anterior chamber.

Sugar,[6] in his classification of glaucoma, places hemorrhagic glaucoma in a separate category. This form of glaucoma may be seen in patients with diabetic rubeosis and also in thrombosis of the central vein of the retina and, clinically, the two types are not distinguishable. Sugar believes that the rubeosis occurs only when there are repeated large intraocular hemorrhages and that the neocapillary formation is a toxic effect due to the disintegrating blood; if the toxic effect of the disintegrating blood is less marked, the rubeosis may antedate the glaucoma by a long time.

Etiologically, the two types of glaucoma are the same, both being associated with massive intraocular hemorrhage and with severe angiosclerotic changes. The presence of albuminous material and extensive vascular membranes in the angle of the anterior chamber in thrombosis of the central vein has been well shown by Samuels, in 1933.[7] He states that the glaucoma "could be caused by a change in the metabolism of the eye, produced by toxic substances derived from the disintegration of red blood cells and a degeneration of the stroma of the vitreous."

The rupture of the thin-walled vessels when the tension if the eyeball is suddenly reduced by surgical procedures, is the reason the eye fails to respond to antiglaucoma operations.

Hemorrhagic glaucoma differs from simple glaucoma in its acute malignant onset with vascular congestion, and from true acute congestive glaucoma in that the anterior chamber is of normal depth rather than shallow.

Report of a case

History. F. W., a 53-year-old white woman, was seen on the eye service of the Morrisania City Hospital in December, 1944, complaining of a red, painful right eye of one week's duration. Examination in 1941 had revealed a corrected visual acuity of 20/40 in each eye; diabetic retinopathy and incipient cataractous changes were present in both eyes at that time.

The patient was a diabetic of 30 years' standing and had been taking insulin for the preceding 12 years. The diabetes was always easily controlled on 15 to 18 units of Protamine Insulin. There had been one episode of pyelitis. There had been 10 pregnancies with 4 miscarriages.

General examination revealed an obese woman with some evidence of weight loss. The heart was moderately enlarged. The blood pressure was 210/100 mm. Hg. The urine contained 4+ sugar but no acetone; 20 W.B.C. per H/p/F. The diabetes was easily controlled.

Examination revealed a visual acuity of 5/200 in each eye, not correctable by lenses. The right eye was markedly tender to palpation and there was minimal edema of the upper lid. There was marked ciliary injection. The pupil measured 5 mm. in diameter, and was fixed to light and for near. The pupillary border was irregular; two fine posterior synechias were seen below. The pupillary portion of the iris was light red in color and contrasted markedly from the brown ciliary portion. The color of the iris was due to the presence of numerous new capillaries, so small and so closely packed

together that even with the aid of the corneal microscope they were barely distinguishable individually. These vessels ran to the pupillary border and disappeared from view; they occupied the surface of the inner third of the iris and from this capillary net larger vessels ran radially into the angle of the anterior chamber where they could not be followed.

The cornea was steamy and the angle could not be examined gonioscopically because of the corneal edema. An aqueous flare was present but there were no precipitates on Descemet's membrane.

The surface of the iris not covered by the capillary net showed the normal pattern differentiation and no filling in of the crypts by newly formed tissue. The vessels appeared to run on the surface of the iris. Incipient cataractous changes were present and the fundus could not be visualized. Tension measured over 90 mm. Hg (Schiøtz). Transillumination was normal.

The pupillary responses in the left eye were physiological and the iris itself showed no abnormalities. Incipient cataractous changes were present, and the fundus could not be visualized. Transillumination was normal.

Treatment. After repeated instillations of atropine into the conjunctival sac of the right eye, the pupil dilated easily with the exception of the area anchored by the posterior synechias below. Tension dropped to 45 mm. Hg (Schiøtz) and the patient felt relieved of her pain. The corneal edema cleared somewhat, and the neocapillary formation on the iris appeared less prominent. The patient refused surgery and during the following six weeks vision fell to light perception.

Ocular tension during this interval was never controlled; it was observed that under miotics the tension would rise and would fall with mydriatics. The patient was most comfortable when the pupil was dilated. The patient finally consented to operation and a paracentesis of the anterior chamber was performed; as the aqueous escaped, the vessels on the surface of the iris dilated rapidly and ruptured. The anterior chamber was completely filled with blood.

Following operation, the ocular tension always remained over 90 mm. with considerable pain which was relieved somewhat by atropine. A hyphemia, measuring about 3 to 5 mm. in height, was continuously present. The rubeosis did not change in appearance. This eye was enucleated four months after operation.

Course. In February, 1945, three months after the onset of rubeosis of the right eye, the left eye became red and inflamed and presented the picture of rubeosis iridis similar to that previously observed. The vision had fallen to hand movements and the tension was over 90 mm. Hg. The tension was reduced to 45 mm. by the use of miotics. On attempting to inject novocain and adrenalin retrobulbarly, a retrobulbar hemorrhage was encountered, the eyeball became proptosed, and the tension rose again to over 90 mm.

The patient consented to operation, and a posterior scleral trephination was performed. At operation, the ocular tension was decreased slowly by expression of vitreous, with clearing of the corneal edema and relief of pain. There was no rupture of the capillaries on the iris. Tension was reduced to 20 mm.

The day after operation, the tension rose to 45 mm. Hg, and a large gelatinous exudate was present in the anterior chamber. The pupil was dilated rapidly with atropine, the patient was given sulfadiazine orally and within 24 hours, the gelatinous exudate disappeared. A small hyphemia had appeared and the rubeosis was not prominent.

During the next two weeks, tension was always moderately elevated but could always be massaged down to normal. The time then came when the elevated tension could not be massaged down and a Lagrange sclerectomy was performed with very little associated bleeding in the anterior chamber. The

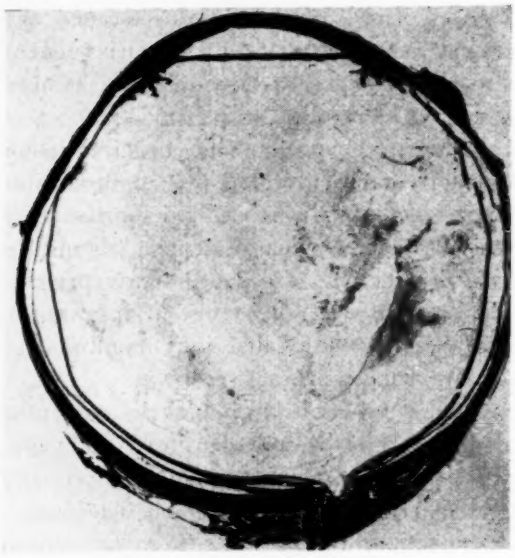

Fig. 1 (Lisman). Section demonstrating broad anterior peripheral synechia and deep glaucomatous cupping.

tension remained normal for two weeks postoperatively and then there were repeated hemorrhages into the anterior chamber and marked elevation of tension and loss of normal light projection.

Over a period of 10 months, the iris gradually became atrophic and the rubeosis almost obliterated. At one stage, the vessels crossed over the pupillary border on to the surface of the cataractous lens; even these vessels in time disappeared.

Histologic examination. (Dr. S. Gartner)

"There is an extensive infiltration of small round cells and hyperemia at the limbus. The anterior chamber contains a fibrinous exudate, some of which is adherent to the corneal endothelium. The angle of the anterior chamber is blocked by broad anterior peripheral synechias.

The iris is extensively attached to the periphery of the cornea (fig. 1). The anterior surface of the iris, especially in the part not adherent to the cornea has an additional layer of newly formed connective tissue which is vascularized with many small and medium-sized vessels and characterized by very thin walls. The older iris

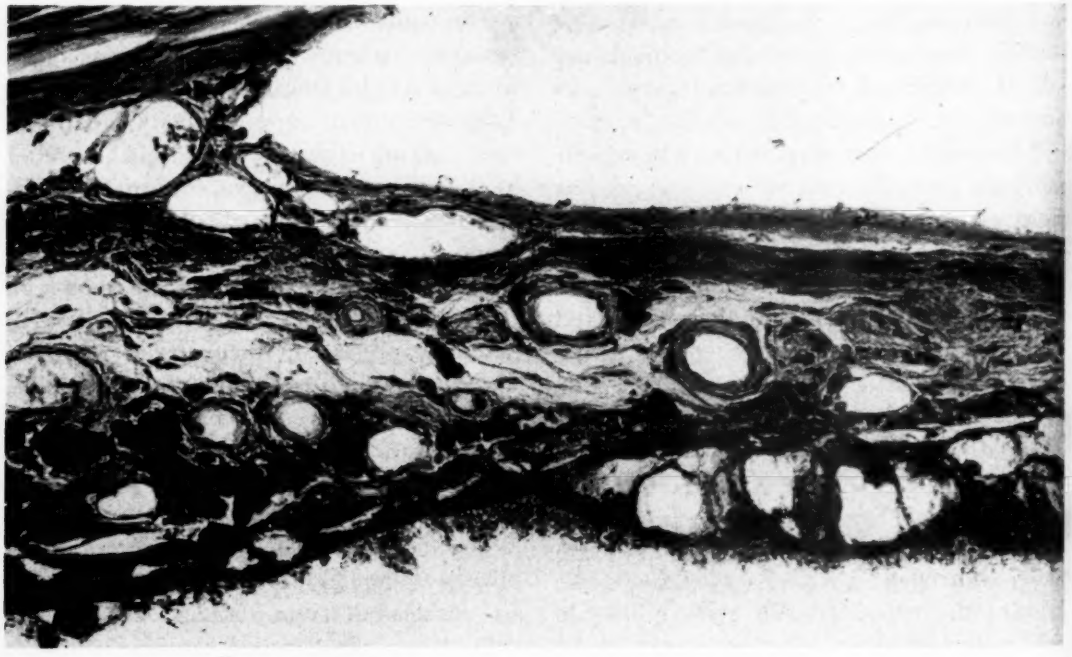

Fig. 2 (Lisman). Section showing layer of connective tissue and blood vessels on the iris surface and extending into the angle. The thin-walled vessels in this layer contrast markedly with the older iris vessels with characteristic thick adventitial coats.

vessels have the characteristic thick adventitial coat (figs. 2 and 3).

The pigment epithelial layer has been transformed into a thicker and irregular

Fig. 3 (Lisman). Layer on the iris surface.

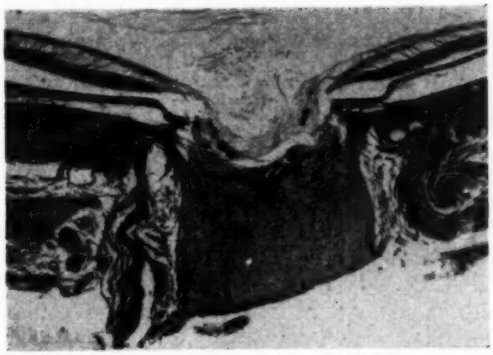

Fig. 5 (Lisman). Section showing atrophic cupping of the optic disc and newly formed connective tissue obstructing the central retinal artery.

layer honeycombed with cystic spaces. Some of the pigment epithelium has migrated into the iris stroma, which is thinned and atrophic (fig. 4). The ciliary body is normal.

The retina shows scant changes in the periphery and considerable at the posterior pole, where there is a paucity of ganglion cells, cystic spaces in the internal plexiform and internal nuclear layers. These cystic spaces may be the signs left by lipoid exudates which dissolved in the preparation of the section.

The external plexiform layer contains

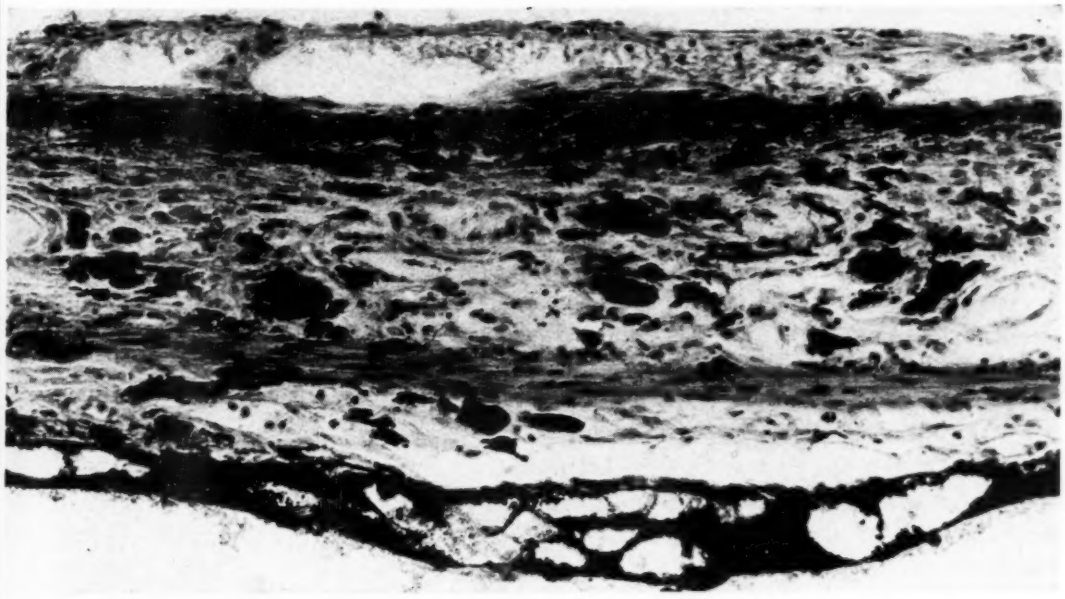

Fig. 4 (Lisman). Section demonstrating the cystic transformation of the pigment epithelium characteristic of diabetes.

some lipoid exudates. The optic nerve is atrophic. There is deep glaucomatous cupping of the disc (fig. 1). The central retinal artery at the nervehead has newly formed connective tissue in its lumen which almost obstructs it (fig. 5).

Diagnosis. Rubeosis iridis, peripheral anterior synechias, pigment epithelium cysts, optic atrophy, diabetic retinopathy, central retinal artery endarteritis, and secondary glaucoma.

Conclusion

The glaucoma associated with rubeosis iridis is an inverse glaucoma, since the ocular tension is more easily controlled by mydriatics. This is probably due to a mechanical squeezing out of blood from the vascular bed on the iris as the vessels are compressed in a dilated pupil. A scleral trephination can reduce tension slowly without danger of rupture of the capillaries on the iris; however, the tension is not controlled for long.

Summary

A case of rubeosis iridis in a diabetic is reported. Medical and surgical treatment was of no avail and blindness resulted. One eye was enucleated and histologic examination was possible.

654 Madison Avenue (19).

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Historical Miniature

Diabetic cataract, as an etiologic entity, was first recognized by T. W. G. Benedikt in 1842. He was educated at Leipzig and Vienna. In 1812, at the age of 27 years, he was made professor of surgery and ophthalmology at the University of Breslau, and remained there until 1856. He died at Breslau in 1862.

Hirschberg, *Graefe-Saemisch Handbuch.*

NOTES, CASES, INSTRUMENTS

REFRACTION CLINIC*

DISCUSSION BY
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A 17-year-old student was unhappy with her present glasses which had been prescribed one year previously. She had no headaches, but stated that when she read, the print would run together. These symptoms of near difficulty were made worse by the wearing of the glasses, but were also present when she wore none. She found the glasses helpful at the movies, since they made her see a bit more clearly. Her visual acuity without glasses was 20/50 in the right eye, and 20/70 in the left eye. Retinoscopy (corrected) without drops was: +4.5D. sph. ⌒ −1.5D. cyl. ax. 180°; +5.0D. sph. ⌒ −2.5D. cyl. ax. 180°; revealed presence of a relatively high hyperopic error associated with astigmatism. Wearing: O.D., −1.0D sph. ⌒ −1.25D. cyl. ax. 180°; O.S., −1.25D. sph. ⌒ −2.0D cyl. ax. 180°. Subjective fog test revealed the following prescription:

O.D., 20/50 with a +3.25D. sph. ⌒ −1.25D. cyl. ax. 180° = 20/50
O.S., 20/70 with a +4.0D. sph. ⌒ −2.5D. cyl. ax. 180° = 20/50
} 20/30, O.U.

Muscle balance was tested and found to be within normal limits. A 2-percent solution of homatropine was instilled over a period of an hour, along with two drops of paredrine and, another hour after that, refraction was again measured. At that time, she accepted, with drops, the retinoscopy (corrected) findings: +5.0D. sph. ⌒ −1.5D. cyl. ax. 180° = 20/40; +5.75D. sph. ⌒ −2.0D. cyl. ax. 180° = 20/50.

DISCUSSION

Discussion will bring out a number of questions.

1. "How is it possible that such an obviously gross error in refraction could be made?"

2. "How is it that the patient was able to tolerate the glasses at all?"

If we analyze her symptoms, she appeared to enjoy her glasses for distance, since she wore them at the movies, and they annoyed her only at near.

One possibility is that in writing the prescription, the ophthalmologist wrote "minus" instead of "plus" for the sphere, in which case, one would assume that the refraction was measured acceptably and undercorrection was purposely prescribed so that the person might get used to her glasses with a minimum of difficulty. This person is young, has an ample amount of accommodation, and is most helped by the astigmatic correction, and could well enjoy the glasses if such a sphere had been written as a "plus." The moral of this observation would be, "Always check the prescription when it is made up." In other words, "Check up on the optician as well as yourself."

A second possibility is that the optician made an error in the signs, and the same moral would apply.

3. It is possible that the examiner did not do a retinoscopy, and, therefore, any spherical lens he placed before the eye, did not improve vision appreciably. We are all aware of the fact that when minus lenses are placed before a young person who has a great deal of accommodation, the patient will observe that the print looks blacker and more distinct, but smaller and not necessarily more readable. So, it may well be that the person prescribed the minus sphere because

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† Director of Department of Refraction.

the patient stated that she saw blacker and more distinctly with them, even though she could read no more.

4. The patient may have had a pseudomyopia produced through a spasm of accommodation. The patient may not have been fogged properly, or may not have responded to a fog effectively, but if retinoscopy were done, this would easily have been discovered.

The second question that arose was "How was it that the patient could tolerate these glasses as long as she did?"

If you will examine the prescription carefully, you will notice that the astigmatism was corrected fairly accurately both as to amount of cylinder and particularly the axis. It is more than likely that the correction of the astigmatism which changed her basic refractive error from that of a compound hyperopic astigmatism to a simple hyperopia without astigmatism, was enough to eliminate some of her visual difficulty. Thus, the remaining amount of spherical error could be compensated for by her accommodation, and the elimination of the astigmatism was enough to make the patient feel better.

At this time, it would be well just to mention some of the ways in which spasm of accommodation can be recognized.

1. When the retinoscopy reveals a much higher hyperopic error than the subjective test; or when the opposite occurs—when a greater error is found by subjective testing than will be elicited by retinoscopy.

2. In the first case, the accommodation is stimulated to a spastic state by trying to read letters or trying to see. Whereas, in the second case, the spasm of accommodation is precipitated by the light flashing into the eye.

3. When near vision produces most of the symptoms, spasm may exist.

4. When during your subjective test, visual acuity fluctuates with a given lens, spasm is present. The best procedure in such cases is to heed the visual acuity report when the vision is at its clearest. For example, you might place before the eyes a strong convex sphere, and the person is able to read 20/40, but then says, "Now everything is all blurred out," or "now it blurs" to 20/70. The 20/40 reading would be the more accurate. For this reason, it is advisable to have the patient close her eyes each time you change a lens, so that you do not excite accommodation from this procedure. Another way of recognizing spasm is when retinoscopy is carried out both with fixation at distance, and fixation at near (using accommodation), and there is a great discrepancy between the two sets of findings. This procedure in itself is not entirely without discrepancy.

Solution

The surest way to have solved this case was by the use of cyclopegia, because then the procedure would have been fool proof. One cannot usually prescribe the full correction as found under cyclopegia without producing complaints in most people of this age who have a refractive error of this magnitude, and have not worn proper glasses before.

I believe one should correct all of the astigmatism that one could be sure of in this case, and then as much of the spherical portion of the hyperopia as the patient will comfortably accept. In most cases, I would say about one third to one half of the spherical portion. In this way, enough improvement in her vision would occur so that she could enjoy her glasses for distance, as well as at near, and still allow her to use some of her accommodation which apparently she has no objections to doing.

I would tell the patient that I am purposely not giving the full strength glass; that it is better to prescribe in graded steps. I would recheck her again in six months, at which time I would give her a fuller correction if accepted, and if her symptoms warranted.

The first prescription that I would prob-

ably give her would be: O.D., +3.25D. sph. ⌒ −1.25D. cyl. ax. 180°; O.S., +4.0D. sph. ⌒ −2.0D. cyl. ax. 180°.

QUESTIONS

House Officer: When you say you would correct as much of the error as she would accept, do you mean to bring her down to 20/20 or 20/15?

Dr. Sloane: Get the best possible visual acuity, whatever it be, 20/30 or 20/70.

House Officer: When the patient returns after six months, as requested, and has no symptoms and is satisfied with her glasses, what do you prescribe?

Dr. Sloane: I personally would make no change in the glass because the more fully one corrects the error, the more dependent will the patient become on her glasses. Since her muscle balance is not adversely affected by the lack of correction of the refraction, the patient can well go along. The patient has a good deal to gain through not becoming entirely dependent upon glasses, particularly a girl, aged 17 years.

House Officer: What are some of the defects in the application of findings from dynamic retinoscopy?

Dr. Sloane: The entire system of retinoscopy with accommodation at play is based upon the fact that convergence and accommodation work on a one-to-one ratio: That is, a diopter of accommodation will stimulate one meter angle of convergence and vice versa. This is not a hard and fast situation.

The exercise of convergence will also act as a check on the excessive use of accommodation. For example, looking at one-third meter, the person will use 3-meter angles of convergence. Therefore, he will only be able to use, according to this theory, 3 diopters of accommodation—the convergence holding the accommodation in check. Thus, if you retinoscope at a near distance, the amount of convergence employed will only allow the necessary amount of accommodation for that same distance to be employed. Thus, the movement that you would find with your retinoscope at that distance would be due to the refractive error itself. An allowance for lag of accommodation must then be made. Too many variables are present.

243 Charles Street (14).

ACUTE GLAUCOMA IN AN ADOLESCENT

A. J. BOASE,* M.D.
Kampala, Uganda, East Africa

Dr. H. Saul Sugar (1947), describing a case of acute glaucoma in a young man, aged 27 years, states "This is probably the youngest case of true acute glaucoma on record, having started with prodomata at the age of 17 years." In view of this statement it seems worth while to place on record the following case.

REPORT OF A CASE

The patient is an Indian girl, aged 17 years, who is exceptionally intelligent, speaks perfect English, and until her recent incapacity attended to the bookkeeping in her father's business. Her past medical history is insignificant apart from an operation for "tonsils and adenoids" three years ago. She was brought to me on May 29, 1947, and gave this account.

History. Her trouble started five weeks previously with a severe headache which lasted for five days and was accompanied by progressive loss of sight. The eyes were not red at the outset but became so after a few days (mother's evidence). Her doctor gave drops for the eyes but she does not know what they were. She claimed emphatically that prior to this episode her eyes had always been perfect.

Physical examination showed a well-developed girl in sound general health but obviously blind. She insisted that she could see

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light, although when asked to point at the window, through which bright tropical sunlight was entering, her projection was most inaccurate. Vision was recorded as barely light perception. There was no pain. Apart from some turgescence of the anterior ciliary vessels, suggestive of a caput medusae, the eyes were white. The pupils were widely dilated and inactive. Moderate corneal edema obscured the fundi. The tension in each eye was stone hard to digital palpation. I had unfortunately left my tonometer at another hospital and so missed the opportunity of recording the actual tension. Eserine (1 percent) was immediately instilled and repeated at half-hour intervals.

The patient was seen again two hours later, by which time I had recovered my tonometer. The pupils had contracted considerably but were not small. The edema was receding and a blurred view of the fundi could be seen. The anterior chambers were very shallow. The eyes felt appreciably softer to the fingers, and the tonometric reading was: O.D., 37 mm. Hg (Schiøtz); O.S., 40 mm. An operation was decided upon.

Surgical procedure. Under pentothal-sodium anesthesia, each eye was trephined and a peripheral basal iridectomy performed. The fistulizing operation was chosen because it seemed not improbable that peripheral anterior synechias might be firmly established.

Course. The postoperative course was uneventful with very little reaction, the eyes soon becoming white and the anterior chambers being reformed by the fifth day. The tension, however, was not satisfactorily lowered in spite of apparently good filtering blebs, although it could be reduced by massage. Atropine was used daily till the chambers reformed when eserine ointment (Cusi) was substituted.

Postoperative examination. During this period, the pupils were widely dilated and a clear view of the fundi could be obtained. The discs were seen to be deeply cupped. Vision was now hand movements. The response to eserine was surprisingly rapid, the pupils becoming moderately small by the following day. On the ninth day it was evident that the tension in the right eye was increasing, the tonometric reading was 37 mm. Hg (Schiøtz). A cyclodialysis was performed on this eye, again under pentothal anesthesia. It was observed that the effect of adrenalin drops (before the pentothal injection) was to cause wide dilatation of the pupil despite the thorough antecedent eserinization.

Course. The patient left on the 14th day. She had been having pilocarpine (1 percent) for the previous three days. The pupils were now small, satisfactory peripheral colobomas could be seen, and the Schiøtz reading was: O.D., 28 mm. Hg; O.S., 25 mm. Vision was still barely hand movements.

It should be added that a routine Kahn test was negative, and that in deference to her mother's wishes the patient had a course of sulfadiazine while in hospital.

Discussion

Apart from the age of the patient, the case presents features of unusual interest. The simultaneous onset of acute glaucoma in both eyes of a young girl otherwise in excellent health is alone remarkable. The development of deep cupping of the discs in the short period of six weeks is no less unusual, unless one postulates an antecedent physiologic cup of abnormal degree. Also illustrated is the validity of Sugar's contention that congestion is not necessarily an early concomitant of acute glaucoma. According to the evidence in the case herein presented, the eyes were not red for the first few days during which vision was lost and the tension must have been very high.

Etiologically, the bilateral onset suggests a common systemic cause. But what this might be remains a matter for speculation. A sudden allergic imbalance of the vegetative nervous system, expressed as an angioneurotic edema of the uveal tissue, is an explanation as difficult to accept as to reject

(Vanysek, 1946). The patient is at an age when hormonal control might be unstable, but there is nothing in her physical or psychic make-up to suggest that she is other than a perfectly normal girl. Moreover, if this were a significant factor, surely one would not find acute glaucoma in young adults the rarity it undoubtedly is.

The history of tonsillectomy prompted consideration of proliferative jugular endophlebitis as an etiologic factor (Meyer 1946). But it seemed to be beyond the limit of probability that both jugular veins could follow identical pathologic courses leading to simultaneous crises in both eyes.

Epidemic dropsy was considered, only to be ruled out.

Comment

For how long can an eye tolerate a very high tension without being irreparably damaged? Duke-Elder (1940) advises that, if medical methods fail to convert an acute attack into a chronic congestive phase within 24 to 48 hours, operation should not be delayed. Gradle (1936) would allow 48 to 72 hours for a trial of nonsurgical treatment. The late T. Harrison Butler (1943) cites a case of his own of violently acute glaucoma. "Both eyes had been treated, I think, for a fortnight with atropine; both were stone-hard with widely dilated pupils, and perception of light was abolished—a truly desperate case. I trephined both eyes and the result was incredible. The eyes became soft and lost all inflammation, and eventually both recovered, with a final acuity of 6/12."

Despite the small ray of hope afforded by this experience it was felt from the outset that the present case was beyond recovery, and that five weeks of gross hypertension was more than any eye could stand. The outcome has borne out this gloomy prognosis.

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CARCINOMA OF THE INNER CANTHUS AND FOREHEAD

Max Hirschfelder, M.D., and Jack Frost, M.D.
Centralia, Illinois

Slowly advancing epitheliomas of the lid margin or of the canthi are frequently observed in elderly people. They usually are basal-cell carcinomas which demand either excision with plastic repair or treatment by X ray or radium. The following case of a tumor was one of the less common types and, although it seemed to originate in the region of the inner canthus, extended to a much wider area and behaved differently from clinical and pathologic standpoints.

Case report

History. An 85-year-old man, who otherwise was in surprisingly good health, had noted a swelling below the inner right eyebrow for a year previous to medical consultation. During the past few months this swelling had enlarged and extended to the forehead. Subsequently the right upper lid began to swell and to occlude the right eye.

Examination revealed a hard tumor, of the size of a large plum, which was firmly attached to its base. The skin was firmly

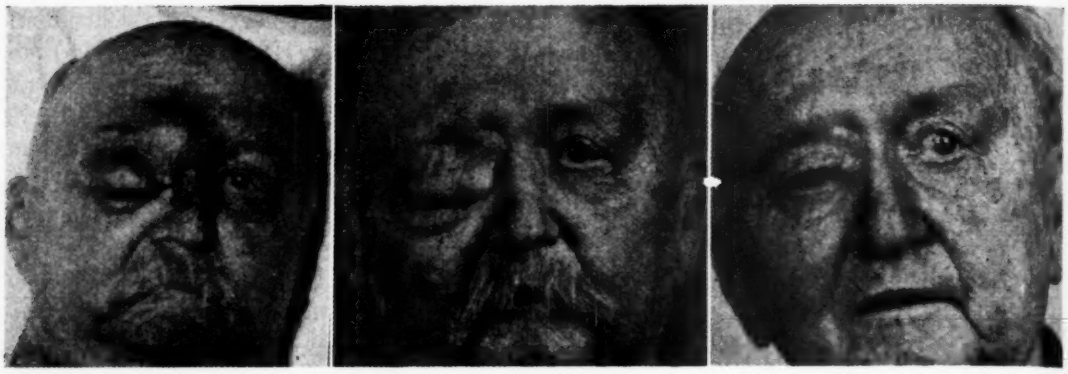

Fig. 1 (Hirschfelder and Frost). (Left) Appearance of the right eye on April 8, 1947, before radium therapy was instituted. (Center) Two months after radium treatment. (Right) Final result on October 15, 1947, six months after treatment with radium and one week after excision of edematous lid.

attached in the region of the inner canthus, where it was drawn in like a little navel. Over the rest of the tumor region it seemed to be movable. The skin over the forehead was smooth. The right upper lid looked like a tumor mass, but on examination was found to be composed of soft, edematous tissue, a sort of elephantiasis created by blockage of the lymph channels through the tumor. The right eyeball seemed displaced downward and slightly proptosed. Movements were limited in all directions. The bulbar conjunctiva showed venous hyperemia and edema. Media were clear and the fundus seemed normal. The regional glands were not enlarged.

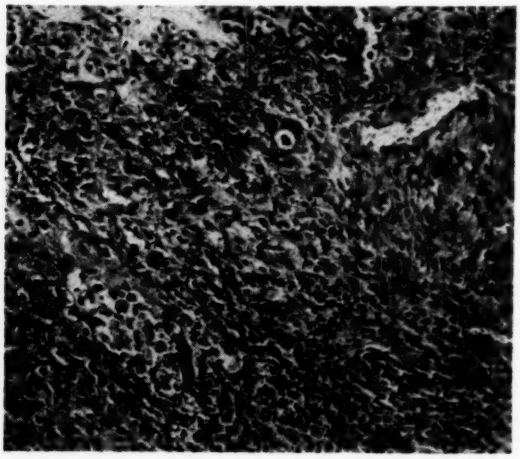

Fig. 2 (Hirschfelder and Frost). A microscopic section of the tumor.

Diagnosis. The X ray did not reveal a definite origin of the mass. There was a certain cloudiness in the right frontal sinus. A biopsy was taken and diagnosed as a squamous-cell carcinoma (H. C. Allen).

Treatment. While there was a definite possibility that this tumor originated from a paranasal (probably frontal) sinus and while the proptosis could have been caused by more than just an orbital edema, it was thought best to avoid extensive surgery in a man, aged 85 years. Radium therapy seemed to provide the best chance for success and, on counsel of Dr. H. Swanberg, Quincy, Illinois, 12 needles containing 15 mg. radium altogether were plunged into the tumor mass under local anesthesia. The needles contained radium ranging from 1.3 mg. to 2.6 mg. They were left in the tumor for a period of one week.

Result. The tumor softened perceptibly during this first week (April, 1947) and disappeared completely during the next two months. On a reëxamination six months after the radium treatment, it was found that the site of the tumor was flat and smooth and no recurrence was noted.

The lid itself was still markedly edematous and a portion, 10-mm. broad and 20-mm. long, was excised together with the underlying tissue. No sign of tumor was found by the pathologist in this tissue.

The eyeball showed a slight downward

displacement, but the engorgement of the conjunctiva had completely disappeared. Movements of the eye were considerably better, even though its position could not be called normal. It was assumed that there was an orbital edema similar to the one of the lid, although remnants of an orbital tumor could not be definitely excluded. The vision was the same in both eyes (20/70, uncorrected) and no radium damage was apparent. No double vision was noted by the patient and he was extremely satisfied with being able to see out of the right eye.

No recurrence of the growth was observed as late as May, 1948.

Comment

The case is presented because of its unusual features. We realize that it is uncertain that our radium treatment effected a permanent cure, and only continued observation and, if needed, another series of radium implants will promise a continued satisfactory result. It can well be argued that a more radical procedure would be better and more certain. There is, however, no doubt that the method used in this case was the easiest on the patient and the least disfiguring. For a man past the age of 80 years, it seemed to us the method of choice.

408 West Second Street.

A DEPENDABLE TYING FORCEPS FOR FINE SUTURES*

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We now have finer eye sutures than we have forceps for tying them. This lack of a suitable forceps led me to experiment with various types of epilating forceps, since they are designed for grasping minute strands.

By micrometer measurement, I found the diameter of eye lashes to vary between 0.0015 and 0.003 inches, with an average of 0.0025 inches (0.0063 mm.). The diameter of 7-0 silk cataract sutures varied less, averaging 0.0026 inches. A cilium, therefore, is just a bit smaller than a cataract suture, a fact which makes a forceps properly designed for grasping the one efficient in grasping the other.

Some cilia forceps are too short to handle well; but the Beupre model is very adaptable and handy for suture tying. This forceps is an old favorite and has been listed in instrument catalogues for the past 20 years. It is of spring-grip construction, and has tapering and closely fitting smooth jaws set at an angle of 30 degrees. The instrument has a total length of about 4½ inches (11.4 cm.) and handles well. The jaws hinge smoothly and present no projections apt to catch the suture in tying an ordinary single or double hemostat knot. A 7-0 suture can be grasped anywhere along the jaws from the tip to the base, a distance of a full centimeter. The jaws open to a width of 4 mm., which makes it easy to pick up a thread.

A canvass of the instrument companies showed that the Beupre forceps was out of production for the present, but it is probable that there is a considerable number of old models about our offices.

The Paton needleholder is a delicate model closely resembling the Beaupre forceps, except that its jaws are slightly wider and heavier, and are straight instead of angular, which is an added advantage. By a little honing, the serrated jaws can be sufficiently smoothed down to grasp a 7-0 suture securely. This model is available† and after the modification just mentioned makes an ideal tying forceps. Most other needleholders either lack the precise bite necessary for tying fine silk or do not open widely enough to facilitate picking up a thread.

490 Post Street (2).

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MECHANICAL FACTORS IN OCULAR PATHOLOGY

Reciprocal relations of injury and disease

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The practical significance of the factors mentioned in this paper appears most striking when related to definite clinical entities in which they play a role—actual, "traditional," or/and recognized, claimed and contested—as not infrequently happens, in criminal and civil courts or before compensation boards. Among these clinical entities, we may mention retinal detachment, glaucoma, interstitial keratitis, and sympathetic ophthalmia.

Before these topics can be intelligently presented, however, it is necessary and worth while to consider, in their general characteristics and manifestations, the role and the nature of the mechanical factors active in the basic processes of ocular physiology, such as circulation of blood and other intraocular fluids, tissue development, metabolism, and intraocular pressure. It is also of equal importance to consider such pathologic changes as atrophy, various forms of cellular degeneration (colloid, amyloid, fatty, and so forth), and the equally varied forms of inflammation—hemorrhagic or specific.

Mechanical factors

There are two categories of mechanical factors: (1) The external, and (2) the local ocular.

External factors

Gravity, barometric pressure, radiant energy, heat, and cold are constantly acting forces in that very close environment, the telluric atmosphere, and have determining and contolling influences on the life manifestations of the individual and the race.

In accordance with their cosmic nature and massive scope, these forces affect the entire body including the eye, although this organ by its position and structure is vulnerable to much less intense and persistent violence.

Local mechanical forces

There is, however, another group of mechanically acting forces that contrasts most strikingly with the environmental agencies. These local mechanical factors act on a smaller scale of intensity and dimensional spread, although the resulting pathologic processes often produce disturbances of function which would seem to be out of proportion to the causal factors.

Resulting pathologic processes

Among these processes we note expanding lesions associated with neoplastic formations, malignant or benign, of a more or less solid nature (callus, dense connective tissue) or semifluid nature (fatty, lipoid, dystrophic), fluid effusions of blood, lymph, and pathologically altered intraocular fluids (vitreous, aqueous).

The modus operandi may consist in pressure atrophy of delicate structures of functional importance, lowered viability and vitality by way of connective-tissue infiltration or scar contraction, actual solution of continuity (a tear or break), and alterations of volume and spatial relations to other structures—conditions almost equally sinister in their implications for so delicately adjusted an organ as the eyeball. Incidentally, these local pathologic changes may result in what clinically constitute actual traumatic lesions.

Indirect complications

Gravity acting upon a sound and healthy eye causes no definite pathologic change and only transient discomfort when an unusual body posture results in a gravitational rush of blood to the head. This observation also

applies to the centrifugal force and communicated motion of intraocular contents. Pathologic changes in intraocular fluids and semifluids may, however, intensify the effect of these processes. The dramatic example is the danger associated with such motions, even within the normal range of extent and intensity, in the presence of fluid vitreous. Under such a circumstance, their agency in causing retinal tear or detachment or in nullifying the effect of an operative procedure for reattachment is well known.

Similar implications apply to the possibility of pathologic changes which are larval, inactive, but potentially hazardous in the reaction of the eye, which harbors them, to some slight trauma or to some other forms of eye disease. For example, a potentially virulent spirochaetae may be quiescent in the cornea or optic nerve but may flare into action if that tissue is subjected to some insult, however trivial.

Circulatory disturbances

It is not at all improbable and may well be assumed that, aside from actual tissue lesions, circulatory disturbances and functional anomalies may form intraocular "fifth columns" and act as clinical conspirators with traumatic violence below the usual levels of causal significance.

In glaucoma, the pupillographic studies of Lowenstein, Schoenberg, and others have shown quite clearly that increased fatigability of the reflex miosis, a latent hazard of pupillary exhaustion, is a definite clinical sign of incipient or prodromal increase of intraocular pressure.

Studies of early signs of disease

Such studies of very early signs of actual eye disease and/or of a definite predisposition thereto must be taken into account in the interpretation of the reciprocal relations between ocular pathologic processes and trauma.

Evaluation of chronology will depend for accuracy on our definite knowledge of a starting point for the eye affection in question. With this knowledge we can reach a definite conclusion as to the rate of progress of the disease. A correct decision as to this is of obvious importance in the matter of lenticular opacities, but there are other conditions in which it is of practical importance to reach a correct decision as to the starting point of the disease.

Previously sound eye

This brings one to a discussion of the "previously sound eye," a concept that logically must be taken into consideration in any attempt to decide whether or not a given injury is antecedent to the existing pathologic condition of the eye.

The assumption that an eye was "sound" at the time of injury is generally made on the absence of evidence, clinical or otherwise, of previous eye disease and on a similar lack of record to that effect. Signs of disease, like those of injury, are often evanescent, or so slight as to be overlooked, ignored through carelessness or failure to use all the finer methods of examination for their detection.

This negates the validity of any decision except one based on previous, periodic eye examinations. Thus, the halos of increased intraocular pressure, the presence of foreign bodies, peripheral lens opacities, slight but pathognomonic lesions at the ora serrata, incipient atrophy, even tears may not be discovered until after an injury to the eye has been sustained and a careful study of ocular conditions brings these changes to light. It is then that definite knowledge replaces assumption.

311 Rockaway Avenue.

SOCIETY PROCEEDINGS

Edited by DONALD J. LYLE, M.D.

NEW YORK SOCIETY FOR CLINICAL OPHTHALMOLOGY

October 6, 1947

DR. DANIEL KRAVITZ, *president*

SYMPATHETIC OPHTHALMIA OR PHACOANAPHYLAXIS?

DR. DANIEL KRAVITZ said that the possibility of sympathetic ophthalmia has caused the removal of many eyes, probably in some cases unnecessarily. On the other hand, procrastination has resulted in a nightmare to many an ophthalmologist.

The case reported by Dr. Kravitz was of a man, aged 70 years, who was examined on November 4, 1946, with a history of sudden loss of vision in both eyes, severe headaches, and vomiting for over 24 hours. For many years he had been treated at the out-patient department of the Kings County Hospital for chronic glaucoma of the left eye. His vision, taken on examination by another ophthalmologist in September, 1946, was 20/200 in the right eye, improved to 20/100 with a −0.75D. sph. Both eyes presented all the classical signs of acute glaucoma and both eyes were stony hard. He was placed on a mixture of eserine, pilocarpine, and cocaine with no appreciable effects, and the following day he was entered at the Brooklyn Hospital where a basal iridectomy was done on the right eye and a modified Lagrange operation on the left eye. Convalescence was uneventful and he was discharged on November 11th. On November 13th, the tension was: O.D., 22 mm. Hg and O.S. 20 mm. (Schiøtz) and, it was noted that there were diffuse lens changes in both eyes. He was able to find his way around with difficulty. Because of his poor general condition, he was unable to return until December 12, 1946. Tension in both eyes had remained the same and he saw just enough to get around. At his next visit, January 9, 1947, tension in the right eye had increased to 2 plus, the eye was considerably inflamed, and there were many deposits on the posterior corneal surface.

His next visit was on January 29, 1947, at which time his eye was stony hard and very painful. He presented the picture of a severe plastic iridocyclitis. In the 3-week interval between the last two visits, he had seen several ophthalmologists, most of whom advised enucleation. The left eye was white and free of any signs of inflammation. Removal of the right eye was urged, and the following day it was enucleated at the Brooklyn Eye and Ear Hospital. He was discharged two days later.

On February 5, 1947, seven days after removal of the right eye, the left eye was white, there were no signs of inflammation and he was able to grope his way around. Tension was 20 mm. Hg (Schiøtz).

He was unable to return until February 18, 1947, at which time the tension in the remaining eye was 2 plus. It was red and painful and there were many large deposits on the posterior cornea. He was placed on salicylates, penicillin, hot compresses, and atropine. The patient did not return for further treatment but subsequently entered the New York Hospital, on the service of Dr. MacLean. The further course of the patient is unknown.

SYMPATHETIC OPHTHALMIA VS. PHACOANAPHYLAXIS

DR. J. ARNOLD DE VEER discussed the histopathologic interpretation of sections of the enucleated right eye of the case presented by

Dr. Kravitz. While the clinical course suggested sympathetic ophthalmia, the picture found in the enucleated eye was that of endophthalmitis phaco-anaphylactica. The following alternative interpretations of the case were suggested and discussed:

1. That a bilateral phaco-allergic reaction may have occurred, such a phenomenon representing a type of sympathetic ophthalmia.

2. That the phaco-allergic postoperative inflammation had been the precursor of sensitization to uveal pigment and that sympathetic ophthalmia had supervened, although not yet identifiable histologically at the time of enucleation of the exciting eye.

Because the patient had passed from their supervision prior to the sectioning of the enucleated eye, no immunologic studies were made by the reporters of this case.

Clinical aspects of sympathetic ophthalmia

Dr. Harold H. Joy said that the foremost predisposing cause of sympathetic ophthalmia is a perforating wound involving the ciliary body or the root of the iris, particularly if there is incarceration of uveal tissue or lens material. As a rule, the exciting eye undergoes a prolonged low-grade uveitis with occasional exacerbations and a tendency to phthisis. However, the clinical picture is not characteristic, and sympathetic ophthalmia may follow a violent acute traumatic uveitis or it may occur in the presence of glaucoma or even panophthalmitis.

The incubation period is extremely variable, but usually 1 to 3 months after injury a mild serous iridocyclitis appears in the fellow eye. Less frequently the inflammation originates posteriorly in the choroid. In either case, the process develops into a chronic plastic uveitis characterized by massive cellular reaction, and subject to exacerbations and recurrences. In spite of comparatively mild inflammation, exudation is profuse, and there is early and persistent development of posterior synechias, and gradual secondary involvement of all the ocular tissues. Cataract and glaucoma are frequent complications and, if the latter is not checked, phthisis bulbi ensues.

The only means of making a positive diagnosis is by histologic examination of uveal tissue. However, a presumptive diagnosis may be made if the case fulfills the following conditions: (1) The presence of uveal inflammation in the injured eye caused by exogenous infection. (2) A reasonable interval between the injury and the onset of uveitis in the fellow eye. (3) The presence in the fellow eye of the rather characteristic plastic uveitis. (4) Proof that this inflammation is not due to some other cause.

Sympathetic ophthalmia is much easier prevented than cured, and this can usually be accomplished by removal of the exciting eye before the process has extended to its fellow. Hence, the shorter the interval between injury and enucleation the greater the prophylactic value. Removal of the exciting eye within two weeks after injury always prevents sympathetic involvement, but further delay nullifies, or at least markedly lessens the favorable effect. Eviscerations are not as effective a preventive procedure due probably to the occasional retention of uveal tissues. Prophylactic enucleation is contraindicated if there is reasonable hope of retaining or regaining useful vision. If sympathetic uveitis does not follow within two weeks after enucleation of the exciting eye, the chance of it occurring is slight, and it almost never appears after one month.

It is essential that treatment begin early and be thorough. It is quite generally agreed that enucleation of the exciting eye has little or no favorable effect after sympathetic uveitis is once established. However, until this has been proved, prompt enucleation of a blind exciting eye is indicated, at least in early cases. Practically all that can be done in treating the sympathizing eye is to attempt the establishment of maximum mydriasis. Secondary glaucoma can frequently be controlled by repeated corneal paracenteses. Any

surgical measure involving the uvea should be postponed if possible for at least one year after subsidence of inflammation, and should be preceded by desensitization.

No form of systemic treatment has been proved entirely adequate. The use of massive doses of salicylates and nonspecific foreign-protein therapy appear to be the most effective, particularly if supplemented by desensitization therapy through uveal pigment. The sulfonamides and penicillin have, on the whole, been disappointing and it is too early to assess the value of streptomycin.

The prognosis is always uncertain, due chiefly to variation in degree of severity, the reasons for which are unknown. The most important prognostic factor of which we have control is the early institution of proper and thorough treatment. In such patients a favorable prognosis may be expected in two-thirds of the cases. Unfortunately a great many patients are not seen until the disease is well advanced, and these are apt to result badly in spite of all treatment.

Discussion

General discussion of these three papers followed.

Dr. Andrew J. Rados said that the only possible treatment is the prophylactic enucleation of the exciting eye. An interesting study was made by Dimmer, who stated that during the first World War no case of sympathetic ophthalmia occurred in the armies of the central powers; the English and French army reports were also of similar nature. Dimmer compared these results with the high incidence of sympathetic ophthalmia in the relatively short Franco-Prussian War of 1870-71, and came to the conclusion that the disappearance of sympathetic involvement was due to the timely enucleation of the offending eyes.

The anaphylactic theory of the sympathetic ophthalmia was based on the theory of Elschnig-Bail, that the uveal pigment has an organ-specific quality and leads to hypersensitiveness of the uvea of the fellow eye. My own research of uveal-pigment specificity with complement fixation tests contradicted the organ-specific results of Elschnig, disproving the anaphylactic origin due to uveal pigment. Later on von Szily, one of the best known research workers in the domain of anaphylaxis, came to a similar conclusion; namely, that sympathetic ophthalmia cannot be explained theoretically as anaphylaxis due to pigment antigen. The negative outcome of his experiments led him to search for other possibilities, like neurotropic viral infection.

Sympathetic ophthalmia after enucleation usually occurs only in the first 14 days, and is extremely rare after this period, which would not be the case if it were due to pigment anaphylaxis. Once the organism is sensitized the so-called anaphylactic reaction would hardly be so promptly prevented by removal of the offending eye. The second very important objection is the fact that sympathetic ophthalmia never appears in the form of an acute uveitis in the second eye but frequently is seen in the form of neuroretinitis. If one would accept pigment anaphylaxis as the explanation of sympathetic ophthalmia, then the cases of sympathetic neuroretinitis are unexplainable, because the pigment anaphylaxis could establish itself only in such pigment-bearing tissues as the uvea.

Verhoeff and Lemoine conceived the idea of phaco-anaphylaxis in order to explain the postoperative inflammatory reaction of the eyes with extracapsular extraction. The followers of their theory never tried to explain the involvement of the other eye on the basis of phaco-anaphylaxis. If one accepts the idea of phaco-anaphylaxis of the first eye, then the intracapsular removal of the lens of the other eye would eliminate the possibility of the lens anaphylaxis because the lens antigen could act only on the lens of the other eye, but not on the uveal tissues. The clinical observation that the discission of juvenile cataract of one eye (where the

entire lens masses remain for spontaneous absorption) is rarely the cause of a postoperative uveitis of the operated eye and never results in a uveitis of the fellow eye contradict the possibility of phaco-anaphylaxis as the basis of sympathetic ophthalmia of the second eye. Finally it should be mentioned that the histologic picture of sympathetic inflammation differs greatly from that of anaphylactic inflammation.

Dr. Isadore Givner said that he agreed with Dr. Rados that sympathetic ophthalmia and endophthalmitis phaco-anaphylactica are two distinct entities. He cited a case, which he felt did not bear out Dr. Rados's contention that, in endophthalmitis phaco-anaphylactica, it is necessary to have the lens of the second eye opened before changes can occur in the second eye.

The patient, a woman aged 74 years, had bilateral cataracts, a history of asthma, and her blood pressure was about 200/100. On May 7, 1946, a combined extracapsular extraction was performed in the right eye. The operation was uneventful and, except for the fact that a small quantity of lens cortex was left in the anterior chamber after irrigation, the eye looked and did well.

On June 3rd, a few keratic precipitates were noted in this eye. These were large and connected with fibrin strands, the type of keratic precipitates that are seen as an allergic response to lens material and not infection. The eye remained white and except for a secondary membrane was in excellent condition at the end of July.

On August 1st, the left eye developed a secondary glaucoma with keratic precipitates and a tension of 90 mm. Hg (Schiøtz). Positive transfer showed a 4-plus reaction to lens antigen. An iridencleisis with sclerectomy was performed, which controlled the tension. After a discission of the secondary membrane, vision of 20/20 was obtained in the right eye; the left eye went on to phthisis bulbi.

Dr. Posner concluded that this case suggested that enucleation of the first eye is not indicated in endophthalmitis phaco-anaphylactica and, therefore, the clinical differentiation from sympathetic ophthalmia is important.

Occlusion of the Central Retinal Artery

Dr. Abraham L. Kornzweig presented a case with sudden loss of vision of the right eye in a woman aged 72 years. Examination of the fundus revealed a partial occlusion of the central retinal artery, and edema of the macula. The vision of the left eye was 20/30. The patient was observed for two years, during which time there was no improvement in the vision. The arteries of the retina of both eyes showed marked hypertensive changes, such as tortuosity, increased light reflex, and compression of the veins.

This patient died, and both eyes were obtained. The right eye was sectioned serially in order to determine the condition of the arteries which had become occluded. The important serial sections of the eye were shown. The artery was traced from a distance of about one-half inch from the optic disc through the lamina cribrosa and on to the dics. The central retinal artery was narrowed but patent. Several sections that were stained with the Weigert-Elastica stain showed evidence of fibrous bands in the lumen of the artery. The artery was distinctly narrowed, almost to the point of obliteration, as it passed through the lamina cribrosa. On the disc, one vessel showed marked narrowing and what looked like recanalization. The retina showed atrophy of the internal layers up to the internal nuclear layer, which was thinned down to one row of Müller's nuclei. The macula was also seen and it was considerably atrophic.

Because of the absence of complete occlusion of the central retinal artery by embolus, thrombus, or endarteritis, a spasm of the artery was considered as contributing to the closure of the vessel.

Bernard Kronenberg,
Secretary.

LOS ANGELES OPHTHALMOLOGICAL SOCIETY

October 21, 1947

Dr. Orwyn H. Ellis, *chairman*

Clinical radium and roentgen therapy

Dr. Ian Macdonald (by invitation) presented the action of the different rays and their effect on living tissue. The alpha rays are extremely caustic and produce flash burns. In beta radiation the electrons are travelling at high speed, and filters are used to produce emanations of 95 to 98 percent. Gamma rays are produced by electromagnetic radiation, are extremely penetrating, and require 25 centimeters of lead to filter completely.

The essentials for determining the radiologic effect are quality, intensity, and quantity. In inflammatory states, before the pyogenic stage, irradiation may produce resolution without suppuration. Chronic inflammatory states, such as tuberculosis of the lids, will respond quickly to irradiation. For eyelid conditions, beta radiation is usually advised. Basal-cell carcinoma responds to low voltage X rays, with the eye shielded. The deep penetrations of retinoblastoma usually respond well to therapy. Since nerve tissue is practically unaffected by X ray, extremely high doses can be given.

Radium salts in monel metal capsules are the most practical for short beta radiation treatment. In the treatment of inflammatory conditions, it is important that the cells are not destroyed, that the changes are reversible so that the cells can return to normal. In the treatment of neoplasms the destructive change is desired, so that the cell changes are irreversible.

Chemistry and biochemistry of the vitreous

Dr. Richard Winsler (Department of Chemistry, University of Southern California, by invitation) presented a detailed technical discussion. The vitreous is a collagen gel, or a series of alveolar sheets. The fibers seen on pathologic preparations are artefacts in fixation products, and the evidence for membrane existence is poorly substantiated. The osmotic pressure is in equilibrium with the aqueous and serum, and cannot be responsible for swelling in pathologic conditions. Swelling of the vitreous can be varied by changes in the pH, but not in the physiologic range. The fractionation of proteins and the composition were reviewed, and it was pointed out that the vitreous has mucoprotein and residual protein not present in aqueous and serum. Glucosamine plus glucuronic acid produces hyularonic acid, the latter is probably primarily responsible for the viscosity of the vitreous. The relative metabolism of the vitreous is very low, and there is doubt as to whether there is any oxygen consumption at all. Dr. Winsler closed this interesting evening with the challenge that the mysteries of the vitreous were still mostly unexplored. At least part of the etiology of glaucoma might be uncovered.

Daniel B. Esterly,
Secretary.

COLLEGE OF PHYSICIANS OF PHILADELPHIA

Section on Ophthalmology

October 23, 1947

Dr. Burton Chance, *chairman*

Retinoblastoma cured by radon

Dr. Joseph Waldman and Dr. Charles E. G. Shannon presented a proved case of retinoblastoma (microscopic and gross study of the enucleated eye) that had been treated and observed for 12 years. Retinoblastoma in the remaining eye had been treated and cured for a period of nine years (1938).

Enucleation of the left eye was performed in 1935 when the patient was aged 10 months. The optic nerve was microscopically free of tumor cells.

Roentgenotherapy to the right eye was given. It will be noted that the total of 3,104R units given was far below the dose advised by the fractionated method of Martin and Reese. In November, 1938, 2½ millicuries of radon were applied in dental compound and sewed to the overlying sclera. Following this, 1 application of 2½ millicuries, 3 applications of 5 millicures, and 1 application if 7½ millicuries of radon were used in a previously described holder (Waldman, J.: Arch. Ophth., 24: (Jan.) 1940) from March, 1939, to May, 1942. The patient was 10 months old when treatment was instituted, and is 13½ years old at this time.

Typical irradiation cataract and fundus changes, probably incident to radon therapy, were described. Visual acuity was 6/60. The patient attends a sight-saving school.

The lens changes and perhaps the macular changes, too, may become more marked. In retrospect, the areas thought to be new growths in April, 1942, may quite possibly have been a late reaction to the radon applied previously. This condition has been noted and described by Martin and Reese in their large series treated by fractionated roentgenotherapy.

Conclusions. We can do no better than to endorse the procedure of Martin and Reese in the treatment of retinoblastoma:

1. *Unilateral* ocular involvement—prompt enucleation. Bimonthly ophthalmoscopic examination of remaining eye for one year; trimonthly in 2nd year; every 4 months in 3rd year; every 4 months in 4th year; every 6 months in 5th year.

2. *Bilateral* involvement—prompt enucleation of the more diseased eye and irradiation therapy with idea of saving life and conserving vision in remaining eye, if the growth is not too far advanced.

For ocular and intracranial involvement of relatively easily accessible areas, craniotomy and excision of growths with enucleation are recommended.

The local use of radon by the method described (Arch. of Ophth., 24: (Jan.) 1940) is recommended as another form of treatment of this malignant disease, particularly where the exact and careful technique of fractionated roentgenotherapy described by Martin and Reese is not available.

Discussion. Dr. Charles E. G. Shannon: I would like first to congratulate Dr. Waldman on his excellent paper. I can speak freely as I am in no way responsible for its production. It is entirely Dr. Waldman's.

Unquestionably with an advanced gliomatous growth in one eye, and a beginning growth in the other, enucleation of the more severely involved eye should be carried out at once and irradiation by radium or fractionated roentgen rays in the other eye should be instituted. We are all familiar with the extraordinary success with which Martin and Reese have carried out the fractionated or divided principle of roentgen radiation. However we felt it to be more practical to irradiate the remaining eye in the patient with radon seeds. Our first attempt to implant the seeds on the sclera opposite the site of the growth according to the technique of Stallard was a bit harrowing and, therefore, a different technique seemed necessary. It was at this point that Dr. Waldman solved the problem by the development of what he has termed a "pliable silver-band applicator." It was a most ingenious device, and it proved its value by reason of the comparative ease with which the implantation could now be carried out. Six applications over a period of four years (1938-1942) finally witnessed the complete elimination of the growth.

Dr. William Zentmayer: There are two features in this case that interest me very much. The first is the appearance of circinate degeneration of the retina, inasmuch as it has been observed in other cases. In the *Transactions of the Ophthalmological Society of the United Kingdom,* volume 64, there is a case reported by S. Philips, strikingly similar to Dr. Waldman's, treated with radium. In this case, the circinate lesions appeared just as they did in Dr. Waldman's

so there is evidently some relation between the radium application and the appearance of degenerative changes. Perhaps something similar to what occurs in the lens.

I feel that in the area where the radium was applied, the changes seen are not only destruction of the choroid, but that there is superimposed connective tissue, the result of the action of the radium. This also has been noted in other cases, and particularly in the case I mentioned above. So marked was this, that it was taken by the surgeon to be a recurrence of the growth, and he reapplied radium. He later came to the conclusion that he was mistaken, and what he took to be a recurrence of the growth was the formation of fibrous tissue.

I might say that six years ago I had the opportunity to do an interstitial implantation of a radon seed in a case of retinoblastoma. A child was sent up from Florida who had had the left eye removed for glioma. This diagnosis was confirmed by Dr. Verhoeff. In the eye that remained, the growth was very extensive. It extended from the lower margin of the disc almost to the equator in the inferior quadrant of fundus, the vessels were exceedingly large and tortuous. Through the coöperation of Dr. Pendergrass, I secured some radon needles, and inserted them into the tumor itself. Unfortunately, the child developed whooping cough, and had to be taken from the hospital and was taken home to Florida so there was no observation beyond a period of about a month, but unquestionably, there was already shrinking of the mass. I was told that the child improved so that she could see to go about. Death resulted from spinal metastasis.

Dr. I. S. Tassman: I should like to ask as a matter of information when are you justified in considering a case of this kind cured clinically?

Dr. Edmund B. Spaeth: Just one difference of opinion with Dr. Waldman which is not tremendously important. He spoke of the irradiation cataract changes as due to the radon. I doubt it very much. The extent of dissemination of beta emanations is so short that the position of the radon seeds could not affect the lens. I believe his patient's irradiation cataract is undoubtedly due to the earlier X-ray therapy which was used. I am rather unwilling to have the radon blamed for the radiation cataracts when they probably did not occur from that.

Dr. Zentmayer: It appeared in the case reported in the *Transactions of the Ophthalmological Society of the United Kingdom*, volume 64, 1944.

Dr. Edmund B. Spaeth: Without roentgen therapy?

Dr. William Zentmayer: Yes.

Dr. Edmund B. Spaeth: It is rather interesting.

Dr. Joseph Waldman: Thank you very much, Dr. Shannon, for your comment.

In answer to Dr. Spaeth's remark about the course of X ray (3104R) causing the cataract, rather than the radon, I believe it is a possibility. On the other hand, repeated exposure to radon has been reported as causing the same disturbance. I think that H. L. Hine, F. Moore, H. B. Stallard, and J. G. Milner in the *Transactions of the Ophthalmological Society of the United Kingdom* have reported such cases. (To Dr. William Zentmayer) Is that the reference you have in mind, sir?

Dr. Zentmayer: I think the author is Philips.

Dr. Joseph Waldman: Yes, sir, that is in the same journal—S. Philips.

In answer to Dr. Tassman, I do not know actually when you are justified, but it has been the custom, I believe, pathologically so to speak, to consider a five-year cure. Now, whether you can say cure without adding five years I do not know, so if you want to be exact, I suppose we can say this is a nine-year cure.

Ptosis operation: Friedenwald technique

Dr. Edmund B. Spaeth presented a film

showing operative procedure for the correction of ptosis, according to the Friedenwald technique.

Attention was called briefly to the history of the use of nonabsorbable sutures in ophthalmology. The indications for the utilization of the occipital frontalis in correcting ptosis by this technique were stressed. The technique lends itself best to correcting high degrees of ptosis in young children, as an interim operation, and for the correction of ptosis with flaccid lids in the presence of a completely paralyzed levator.

Discussion. Dr. Francis Heed Adler: The majority of these children with congenital ptosis have marked epicanthus. I have always felt that any operation designed to correct the ptosis was doomed to failure unless the epicanthus was first taken care of, and this generally should not be done before the child is 5 or 6 years of age. This operation looks very simple and effective, and I am wondering whether Dr. Spaeth finds that it corrects the deformity adequately without doing anything for the epicanthus.

Dr. Edmund B. Spaeth: Dr. Adler asked the question about epicanthus and its relationship to ptosis in very young children. It is a most pertinent question. I feel that epicanthus should not be surgically corrected until the child's face has reached an adult size. Most of these youngsters have a very shallow bridge of the nose or none at all. The configuration of the nose of the father or the mother will aid one in forming an opinion of what might occur in these children, as the bridge of the nose develops and elevates. Of course, children do not always develop similar to their parents. Epicanthus frequently continues and needs corrections in spite of the development of a normal bridge. Some rather unpleasant instances have come to my attention of epicanthus, and its correction in the very young years of life by plastic surgeons who were not ophthalmologists. When the time is proper for correction of epicanthus, it is not always a problem of surgery at the inner canthus alone. Frequently the external canthus also needs adjustment because of dissimilar lengths of the lid margins.

Any type of levator surgery which can be done will modify but little the degree of epicanthus present. Some logical ptosis operations will actually augment the epicanthus at that time; namely, such a procedure as the Hunt-Tansley. On the other hand, the Macheck and Gifford operations do modify favorably epicanthus if present at the time the ptosis is being corrected by these techniques. They probably are the only two ptosis operations which do help to correct epicanthus. Unfortunately they have limitations as to their use. Under such circumstances, it again appears that the proper time to correct epicanthus is not when the patients are still in early childhood, but in the later years of child life, or in early adult life. Then that which is still residual, in spite of more mature development, must be corrected. It would seem at the 14th or 15th year of life is perhaps the best time for that surgery.

Severe papilledema in diffuse infections of the nervous system

Dr. Joseph C. Yaskin, Dr. Robert A. Groff, and Dr. Henry A. Shenkin, Philadelphia,* (by invitation) presented this subject.

In most instances a frank bilateral papilledema presents few diagnostic problems since the history of the case, the evidences of focal brain disease, or the presence of acute infection makes the etiologic diagnosis fairly evident. Most cases of papilledema are eventually traceable to space-taking lesions, such as tumor, abscess, subdural hematoma, and less frequently to arachnoiditis, and frank infectious processes of the temporal bone and paranasal sinuses (otitic hydrocephalus, nonsuppurative encephalitis).

* From the Departments of Neurology and Neurosurgery, Graduate School of Medicine, University of Pennsylvania.

We have encountered a number of patients with bilateral papilledema in whom the etiologic diagnosis was difficult but important since some of those patients required operative intervention to save eyesight. It is the purpose of this presentation to report 12 patients in all of whom bilateral papilledema was present, but could not be accounted for on the basis of any of the causes mentioned above.

The 12 cases (average age, 24 years) showed bilateral papilledema and other less marked evidences of increased intracranial pressure. Although no definite etiologic factors could be established, it was felt that the process was probably infectious in nature, but did not fall into the category of arachnoiditis, pseudotumor, otitic hydrocephalus, or localized, nonsuppurative encephalitis of known etiology.

The papilledema varied from 2 to 10 diopters, it was accompanied by hemorrhages and exudates and lacked the characteristics of papillitis. The visual acuity was only slightly impaired, excepting in those patients who had marked papilledema.

The study of the spinal fluid was not helpful in establishing a diagnosis. Ventriculography was performed in 10 cases and ruled out an intracranial mass lesion.

The average duration of papilledema was 3½ months with a range between 1½ and 6 months. Focal brain signs were absent in the majority of patients, and were only confusing in the six patients who presented them.

In addition to symptomatic treatment, some patients were benefited by ventricular drainage; two required a subtemporal decompression, and two were subjected to a suboccipital exploration. Of the 12 patients, 2 died, 5 made a complete recovery, and the remaining developed some degree of secondary optic atrophy and diminution of visual acuity.

The problem of bilateral papilledema of undetermined etiology is not new, and has been discussed previously by a number of investigators. In the course of time, especially with the advent of air studies, more frequent exploratory procedures, and painstaking autopsy material study, new etiologic factors have been ascertained leading to the concepts of arachnoiditis, otitic hydrocephalus, pseudotumor, and nonsuppurative encephalitis. We believe that our series of cases are not included in the above categories, although there must be some overlapping of concepts relating to the etiology and pathogenesis.

In attempting to arrive at an etiologic diagnosis in our cases, it is evident that the increased intracranial pressure was not due to any obstructive lesion. Nor was it likely to be due to any marked edema of the brain since all our patients were alert throughout their clinical course.

It would seem reasonable to assume, therefore, that the increased pressure was due to some factor which either increased the output of spinal fluid or interfered with its absorption. We suggest the presence of some infectious process, reasoning largely by analogy to similar conditions produced by infections of the temporal bone and paranasal sinuses. We cannot exclude toxic or allied factors, especially since the spinal fluids were singularly free from elements of an inflammatory nature. Thus, the absence of pleocytosis would justify the conclusion that the principal mechanism in our cases is one of fluid exchange such as one sees in other parts of the body in allergic or similar reactions.

It is suggested that future ultraspectrophotographic studies of the spinal fluid such as are now being carried on by Dr. Adolph Spiegal in Philadelphia may give us more information on the etiology and pathogenesis of these cases. Such information may help to explain why small lesions on the surface of the cerebrum may give rise to marked increase in intracranial pressure; whereas, large lesions in the vicinity of the ventricles, as, for example, the gliomas of the brain stem, give rise to no papilledema

until late in the course of the disease.

Irrespective of etiology and pathogenesis, these patients present practical problems in diagnosis and treatment. Every case of papilledema with or without other evidences of increased intracranial pressure should be suspected from the start as harboring an intracranial space-taking lesion until proved otherwise. In all patients in whom there is no clear etiologic factor, such as infection of the temporal bone and paranasal sinus, syphilis, system infections or intoxication (lead), or hypertensive encephalopathy, and, unless the patient progresses rapidly toward recovery, there should be an air study. In our experience ventriculography is the procedure of choice since it is safer, causes less discomfort to the patient, and, in most instances, provides the necessary information to exclude a space-taking lesion.

Even more important is the consideration of the management of these patients. In the absence of any known etiologic factor the treatment is largely symptomatic. Several of our patients were probably benefited by repeated ventricular drainages. Five of the 10 surviving patients developed a secondary optic atrophy of varying degrees. We feel reasonably certain that two of our patients owe whatever vision remains to a subtemporal decompression. Considering the seriousness of diminished visual acuity and the relative simplicity of subtemporal decompression, it is our feeling that a decompression should be done more frequently in an attempt to prevent visual impairment. The question of more extensive exploratory procedure must be left to the judgment of the mature clinician and his evaluation of the individual case.

Conclusions. 1. There are patients who have papilledema and other evidences of intracranial pressure probably due to alterations of the cerebrospinal fluid circulation and/or chemical composition of the fluid, the nature of which is unknown. It is suggested that in these cases routine spinal-fluid studies should be augmented by ultraspectrophotographic studies.

2. Unless the progress in these obscure cases is satisfactory from the standpoint of ocular findings, ventriculography should be employed, in that an intracranial mass lesion cannot be definitely excluded without its aid.

3. Operative intervention in the interest of preserving vision should be seriously considered in those cases whose progress is unsatisfactory, despite the inability to demonstrate an intracranial mass lesion.

Discussion. Dr. Francis Heed Adler: The one thing these cases all have in common is a papilledema of unknown origin. I did not hear Dr. Shenkin mention polycythemia vera. I presume that this was ruled out in all of these cases. We have had three patients at the University Hospital which Dr. Shenkin probably knows about in which this was the final diagnosis. All three had choked discs.

Dr. Robert H. Trueman: Mr. Chairman, I would like to add a few words of comment on one of the cases presented by Dr. Shenkin, in that Dr. Spaeth and I had the opportunity to reëxamine her only a few days ago. She was the young girl that had the very high degree of papilledema.

The first time that Dr. Spaeth and I saw the case, in consultation, she had between 4 and 5 diopters of papilledema in each eye with vision of 6/15, bilaterally. We saw the case daily with Dr. Yaskin and Dr. Groff and watched a rapid increase in the papilledema, and a decrease in the visual acuity in each eye. Under conservative therapy, the patient's general condition deteriorated, and the papilledema increased to 10 diopters in the right eye and 8 diopters in the left eye with a decrease in vision to light perception, bilaterally. It was at that time that it was felt that operative intervention was absolutely imperative. Isn't that correct, Dr. Yaskin?

Dr. Joseph C. Yaskin: Yes.

Dr. Robert H. Trueman: It was at that

time that Dr. Groff did the subtemporal decompression. Immediately thereafter the papilledema began to recede, and the visual acuity to improve. At the time of her discharge from the hospital, her papilledema had receded between 2 to 3 diopters in each eye.

At the time of her reëxamination several days ago, we found an optic atrophy secondary to the papilledema, but the remarkable thing we felt, was the fact that in the eye that had had the 10 diopters of papilledema, her vision was now 6/22, while in the eye that had had the 8 diopters of papilledema, her vision was now 6/7.5. Her visual fields showed a moderate concentric contraction for form and color.

I feel that this case should emphasize Dr. Shenkin's closing remark that, in this type of case with rapidly deteriorating vision even without evidence of a space-taking lesion, decompression is essential for the continuation or preservation of whatever visual acuity is present or, as this case has pointed out, for an improvement in that visual acuity following the surgery.

Dr. Joseph C. Yaskin: Mr. President, I should like to emphasize some of the points of our paper since Dr. Shenkin did not have sufficient time to do so. In each of these cases, the outstanding problem was the saving of the eyesight. Most of these patients, when first seen, were suspected of having a brain tumor, but no evidence of any space-taking lesion could be found. Unfortunately, no very distinct evidence of infection could be determined even after prolonged studies.

Because of the ever present fear of blindness, we resorted to measures that we ordinarily avoid. Thus, we did not hesitate to do lumbar punctures in the presence of papilledema. We also did air studies on less than usual provocation.

In some cases, even though preliminary air studies failed to disclose a space-taking lesion, we decided on exploration, because of the desperate condition of the patient. It required a great deal of careful analysis and judgment to decide when to do air studies, and to operate, and in all these matters the ophthalmological findings played a major role.

I am quite sure that two of our patients owe their eyesight to decompressive procedures, and that, without these procedures, they would have been totally blind. One girl had not only subtemporal decompression for the papilledema but, because of the progressively increasing loss of sight, and despite the negative ventriculogram, a posterior craniectomy was resorted to.

Lastly, we have learned from the study of this group of patients that, in the presence of increased papilledema, air studies and decompression should be resorted to even though the process is not due to any definite cranial entity such as tumor, subdural hematoma or arachnoiditis.

Dr. Henry A. Shenkin: In reply to Dr. Adler's question, I cannot say that we eliminated polycythemia in each and every one of these cases, however, I was personally familiar with each patient, and I can tell you these people did not look polycythemic, and, furthermore, the course of the disease, I think, rules out the question of polycythemia.

The only other comment which I would like to make is that, unfortunately, some of these patients come to the hospital in series, and some of the younger residents are impressed with the fact that there may be 2, 3, or 4 cases of papilledema that turn out not to be due to brain tumor, and then for a year after that, they are a little disrespectful of papilledema as an evidence of a brain tumor. In general, I think it should be emphasized that true papilledema is due to brain tumor. Other causes are rare. Papilledema should be regarded as being due to brain tumor until proved otherwise.

George F. J. Kelly,
Clerk.

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THE JUNE MEETINGS

The 17th scientific meeting of the Association for Research in Ophthalmology was held in Chicago on June 21st and 22nd. It was noteworthy for several reasons: the size and excellence of its program and the bestowal of the first Proctor Medal.

Since its origin until the present, the association has held its meeting on one day only and limited the number of papers that were presented to 10 or, at the most, 12. It is an evidence of the marked growth and development of experimental ophthalmic research in the United States that 24 excellent papers were on the program.

Some of these presentations, notably those of Frenkel; Leopold *et al.;* Harris and Gehrsitz; Kinsey and Barany; and Newell and his associates, were particularly outstanding. Elsewhere in this number of the JOURNAL will be found the complete program.

Approximately 160 members and guests were in attendance. Most of these members were present at the association's banquet the evening of June 21st and witnessed the

presentation of the first Proctor Medal for ophthalmic research to one of its most distinguished members, Jonas S. Friedenwald of Baltimore. The award was made by Francis Heed Adler of Philadelphia, and was modestly received by Friedenwald who paid generous tribute to his co-workers of 25 years in outstanding research at Johns Hopkins Hospital.

In his acceptance address, Dr. Friedenwald spoke of the evolution of medical progress from the Natural-History stage through the era of Clinical Research. He pointed out that important discoveries from clinical studies are becoming fewer as the field is gleaned, while the era of experimental investigation into the basic problems of medicine is still unharvested and is, so far, inexhaustible.

He mentioned the pleasure and excitement to be found in experimental work. No one will agree with him, however, that the work is easy unless he is a master of modern techniques in chemistry, physics, and mathematics, as is Friedenwald.

The Proctor Address, given by Dr. Friedenwald the following morning, summarized his studies of the past 25 years on the "Formation of the Aqueous." It was a fascinating exposé of the painstaking work and laborious steps in the attempt to answer this fundamental problem of ophthalmic physiology.

On June 23rd, the scientific session of the Section on Ophthalmology of the American Medical Association began. John A. MacMillan of Montreal, Canada, was the guest of honor of the section. The subject of his address was "Diseases of the Lacrimal Apparatus." It is pleasing to note that Dr. MacMillan was elected an associate member of the A.M.A. by the House of Delegates.

The chairman of the section, Everett L. Goar, in his address, discussed "Ophthalmic Education and Results in the United States."

Thirteen other scientific papers were read and well discussed. The program was excellent. Among the outstanding contributions were those of Reese on "Retrolental Fibroplasia and Persistent Hyperplastic Primary Vitreous: Two Entities"; Ingalls on "The Epidemiology of Encephalo-ophthalmic Dysplasia"; "The Use of D.F.P. in Glaucoma," by McDonald and Leopold; "The Blindspot Syndrome," by Swan; and "The Use of Streptomycin and Streptomycin Plus Promizole in Experimental Ocular Tuberculosis," by Alan C. Woods.

The Research Medal of the section was presented to Alan C. Woods of Baltimore by Francis Heed Adler in the name of the executive committee of the section. The important and significant contributions of Dr. Woods in the fields of ocular immunity, allergy, sympathetic ophthalmia, tuberculosis, and uveitis were cited.

Unlike the Proctor Medal, the Research Medal of the section is granted for both clinical and experimental research. The choice of the recipient for this year's medal was a popular one.

A gold medal of the A.M.A. for scientific exhibits was given to Bertha A. Klien, department of ophthalmology, Northwestern University, for her splendid exhibit on "Diseases of the Fundus Oculi"; a bronze medal was awarded to William Stone, Jr., Massachusetts Eye and Ear Infirmary, for his exhibit on "A New Type of Movable Implant"; and John G. Bellows and Chester J. Farmer, of Northwestern University Medical School, received a certificate of merit for their exhibit on "Treatment of Ocular Infections: Use of Chemotherapeutic Agents."

After many years of devoted service, Arthur Bedell resigned as delegate of the section to the House of Delegates. A rising vote of thanks for his service to the section was evidence of the esteem, affection, and gratitude felt by the members of the section for Dr. Bedell. William L. Benedict of Rochester, Minnesota, was elected the delegate to replace Dr. Bedell.

M. Hayward Post, Jr., of St. Louis, was elected chairman, and Brittain F. Payne of New York, vice chairman, of the section for 1949.

The section recorded its support of the resolution adopted by the House of Delegates in 1947, condemning the acceptance of rebates and calling for punitive measures against members and fellows of the American Medical Association who are guilty of the practice.

The secretary, Trygve Gundersen, was appointed to represent the section on a joint committee with other ophthalmic organizations to investigate the use of penicillin as a prophylactic agent against ophthalmia neonatorum. A committee of the section to act jointly with representatives of the other ophthalmic organizations to celebrate in 1950 the centenary of the discovery of the ophthalmoscope by Helmholtz was proposed.

In spite of the rather small attendance, about 300 members having registered, the meeting was interesting and successful. The 1949 session will be held in Atlantic City, June 6th to 10th.

Derrick Vail.

OBITUARY

WALLACE PYLE
1875-1948

Dr. Wallace Pyle died June 10, 1948, at his residence in Orange, New Jersey, after several weeks' illness.

He was born in Jersey City, New Jersey, a son of the late Dr. Edwin Pyle. He attended the University of Michigan for two years, and then entered the Medical School of the University of Pennsylvania, from which he received his degree in medicine in 1897. He interned in Christ Hospital, Jersey City, and later became ophthalmologist on the staff of that hospital and several other Hudson County hospitals, including the Jersey City Medical Center.

He was a fellow of the New York Academy of Medicine, the American College of Surgeons, the American Academy of Ophthalmology and Otolaryngology, and the American Medical Association. He was also a member of several local medical societies.

Dr. Pyle was always affable, courteous, and generous. These traits, together with his professional ability, endeared him to his patients and his fellow practitioners. His ethical standards were of the highest. His chief diversion was travel. He made numerous trips to Europe, the far East, Alaska, the western part of the United States, and South America.

His wife, Ida Jarvis Pyle, a son, two daughters, and seven grandchildren survive him; also, a brother, Dr. Edwin Pyle, a physician in Waterbury, Connecticut.

Elbert S. Sherman.

CORRESPONDENCE

SPASTIC MYOPIA AS A COMPLICATION OF GLYCOSURIA

Editor,
American Journal of Ophthalmology:

Various writers have referred to refractive changes in diabetics. I should like to submit the following case which seems to be one of transient myopia accompanying transient glycosuria.

A retired Anglo-Indian lieutenant, aged 61 years, came to the Eye Clinic at Kotagiri, the Nilgiris, South India, complaining of rapidly changing vision. His old glasses (+0.5D. sph. for distance; +2D. sph. for reading) were no longer comfortable and he found that he could read better with no glasses. However, his distant vision without glasses was only 6/9, O.U.

Manifest acceptance on December 12, 1942, was: O.D., −0.75D. sph. ⊂ −0.75D. cyl. ax. 90° = 6/5; O.S., −1.0D. sph. ⊂ −0.25D. cyl. ax. 90° = 6/5. Reading acceptance was: O.D., +1.0D. sph. ⊂

+0.75D. cyl. ax. 180°; O.S., +1.25D. sph. ⊃ +0.25D. cyl. ax. 180.°

As the patient had been taking a strychnine tonic, he was advised to stop this and return for refraction and retinoscopy in 12 days. On December 24th, the repeated tests gave the same acceptance as before.

Glasses with the new prescription were comfortable for a time but after the patient, who meanwhile had learned of a diabetic condition (2-percent sugar), took insulin (5 injections only) and followed a diabetic diet, he could no longer tolerate the new glasses but returned to wearing the ones with the old prescription. By February, 1943, he was no longer able to use the new glasses.

A glucose tolerance test on March 6, 1943, showed: Fasting blood sugar, 75 mg. per 100 cc. After administration of 50 gm. glucose, it rose to 106 mg. at the end of 30 minutes; at the end of 1½ hours, it returned to fasting level, and reached 62 mg. at the end of two hours. Urinary sugar was absent throughout the test, the curve appeared to be normal, and there was no evidence of diabetes.

For some weeks before he discovered 2-percent sugar in his urine, the patient had noticed polyuria and polydipsia. By maintaining a low-carbohydrate diet after the five injections of insulin, he has remained sugar free. Never, since he became sugar free, has he been able to tolerate the new minus lenses prescribed during the time when he was suffering from glycosuria.

Parsons in his *Diseases of the Eye* (p. 591-592) says that in addition to diabetic cataract, retinitis, intraocular hemorrhages, and retrobulbar neuritis which may occur with diabetes, there are "remarkable changes in the refraction of the eye, both in the direction of hypermetropia and myopia," and he attributes this to "alterations in the refractive index of the cortex of the lens."

On page 319 he refers to the lenticular changes in diabetic cataract, and says "there is little doubt that osmotic changes are a prominent factor in the pathogenesis and account for the accumulation of droplets beneath the capsule of the lens."

In 1929, K. K. K. Lundegaard in Copenhagen wrote, "In diabetes mellitus a sudden hypermetropia arises due to alteration in the lens." The onset he described as a "sudden mist" obscuring the vision. But in our patient, there was no such symptom, and the lens remained clear throughout.

Instead of trying to explain the transient myopia with glycosuria in terms of osmosis beneath the lens capsule only, I would like to suggest the possible effect of diabetes on the ciliary muscle as well.

I recall two cases admitted to a large American hospital at different times, and by different resident physicians, both of which had been rushed to the surgical ward as "emergency appendix." In each case, fortunately, the coma and the boardlike rigidity of the abdominal muscles were discovered to be due to diabetic coma before surgical intervention supervened. Insulin produced rapid cessation of all symptoms. Both patients were children from the same home who had formed the habit of frequenting their father's candy shop and feasting on sweets instead of eating the meals their mother prepared for them.

If big abdominal muscles can become spastic with diabetic crises, is it not possible that the transient myopia also is a spastic myopia.

David O. Harrington of San Francisco, (J.A.M.A., *133:* (Mar. 8) 1947) makes no reference to diabetes but in his discussion of "Psychosomatic Disorders" describes a temporary visual disturbance which he considers to be due to a spastic myopia. "This condition," he says, "sometimes called 'ciliary spasm,' is thought to be due to spastic contraction of the ciliary body with resultant increase in antero-posterior diameter of the lens." He considers this to be always associated with emotional disturbance. The ex-

amination revealed "spastic myopia."

Although Harrington makes no mention of the myopia of diabetes, or of transient glycosuria, is it not possible that the pathogenesis of transient myopia with transient hyperglycemia and glycosuria may be a "measurable temporary *spastic myopia*" which appears when there is sugar in excess and disappears when the patient's blood sugar returns to normal?

(Signed) M. Pauline Jeffery,
Buffalo, New York.

BOOK REVIEWS

EL TRACHOMA. By Virgilio Victoria, M.D. Buenos Aires, El Ateneo, 1947. 315 pages, 76 illustrations.

The book is motivated by the desire to correlate the bibliographic data on trachoma with the author's clinical observations, and to stimulate public-health activity for the control of the disease in Argentina. Practicing in Tucumán, a trachoma-infested part of Argentina, Dr. Victoria has a large clinical, administrative, and research experience with the disease.

Of the six chapters into which the book is divided, three are devoted to a description of the clinical and laboratory features, one to therapy, one to the constitutional implications of the disease, and one to the public-health problem, principally as it affects Argentina. A bibliography follows each chapter.

The author rejects the view that invasion with pathogenic microörganisms is a complication of trachoma, and considers this invasion as an integral and constant part of the pathogenic process. He therefore discourages the use of the expression "complicated trachoma" as a misnomer.

In the first three chapters the trachomatous lesions in the conjunctiva, cornea, lids, and the lacrimal apparatus are described in detail, and illustrated with colored drawings and excellent microphotographs of pathologic material examined at the Institute of Regional Medicine of the University of Tucumán.

In the chapter on therapy the various therapeutic procedures reported in the literature are reviewed, and there is a useful and detailed account of the treatment patterns set up by Busacca, and followed in the main by the author in the management of the various phases of the disease.

While the procedure described by Busacca as "kneading-massage" is still the sheet anchor in the treatment pattern, the addition of sulfa therapy is recognized as of great value in hastening cicatrization, shortening the duration of treatment, and eliminating the need for subconjunctival injections. The chapter on surgical management of entropion and trichiasis is clear, concise, and illustrated with excellent drawings by Boltasar Isasi.

No new viewpoints relative to etiology are presented; the author does not believe that lymphatic diathesis, nutritional deficiencies, malaria, syphilis, tuberculosis, and intestinal parasites play any role in the etiology of trachoma, and denies the existence of natural or acquired immunity.

He believes that the great danger of infection is in childhood, and considers trachoma infectious in all its stages. In support of this contention he cites the case of an infant, 35-days old, with follicular trachoma, whose contact was limited to his mother; she had a cicatrized conjunctiva and had had no clinical symptoms for over 10 years.

Population density, low altitude, constant winds and dust, periodic migrations of labor groups without sanitary provisions, are factors favoring the spread of the disease; temperature and humidity appear to be without influence; and hygienic living conditions and the availability of running water diminish its incidence.

From the point of view of public health it may be said that Dr. Victoria is progres-

sive and sound. He advocates control of trachoma under a national public health program because of the greater economic capacity of the national government to support the program, the possibility of uniform prophylactic, therapeutic and technical patterns, and the freedom from interference from local regulations.

Specifically, he advocates supervision in schools, industry, and armed services through traveling dispensaries, educational campaigns, visiting-nurse services, and quarantine of trachoma patients with secretion.

An interesting survey of the trachoma problem in Argentina, of the industrial implications of the disease, and a tabulated analysis of the permanent visual disability of 100 patients conclude the book.

On the whole, this is a very useful volume, particularly for those who are required to deal with trachoma on any considerable scale.

Ray K. Daily.

TRANSACTIONS OF THE SOCIÉTÉ BELGE D'OPHTHALMOLOGIE. April 27, 1947, pp. 1-182.

Seventeen papers and case histories are presented. L. Weekers reports on a modified technique in the surgery of extensive divergent squint. The resected tendon of the internal rectus is attached to the conjunctiva and drawn toward the external rectus.

A. Potvin and J. Helin studied the sedimentation rate in ocular allergic diseases and found that it is of minor importance in diagnosis but of considerable interest in the prognosis of allergic manifestations.

R. Weekers' paper on the symptomatic treatment of ocular hypertension includes a study on D.F.P. and is a survey of his clinical observations. The drug, stimulating the parasympathetic, produces a miosis, a distention of the uveal vessels, and a spasm of accommodation and so changes the aqueous humor and the intraocular pressure. Its action is similar to that of eserine but lasts longer. A single instillation in favorable cases may hold the tension in normal limits for 8 to 10 days.

L. Coppez showed a film demonstrating corneal tattooing with platinum chloride. Van Canneyt and Kluyskens presented three case histories of secondary band-shaped keratitis and the possible etiology of this corneal degeneration.

A. De Jaeger and J. Bernolet suggest canthotomy as a preliminary to retrobulbar injection and akinesia in cataract operations. De Walsche reported on a tumor of the ciliary body whose first clinical symptom was hemeralopia.

In 10 patients with chronic glaucoma, 2 with retinitis pigmentosa, 2 with senile macular degeneration, and 2 with embolism of the central artery, J. Zanen and R. Wibolt could not verify the claim that retrobulbar injection of benzyl imidozoline influences the circulation of the choriocapillaris and retina.

Improvements of the ocular prothesis by using synthetic resin were recommended by R. Weekers and F. Roussel. A. Fritz compared the results of the retinal microphotometry with those of angioscotometry. R. Weekers and Thibert reported on congenital microcorie and M. Appelman on an ethmoidal-lacrimal fistula. Bilateral paracentral scotomas in a patient with an occipital lesion were studied by M. Humblet who also reviewed the anatomy and physiology of the central visual areas.

Alice R. Deutsch.

ABSTRACT DEPARTMENT

EDITED BY DR. F. HERBERT HAESSLER

Abstracts are classified under the divisions listed below. It must be remembered that any given paper may belong to several divisions of ophthalmology, although here it is mentioned only in one. Not all of the headings will necessarily be found in any one issue of the Journal.

CLASSIFICATION

1. Anatomy, embryology, and comparative ophthalmology
2. General pathology, bacteriology, immunology
3. Vegetative physiology, biochemistry, pharmacology, toxicology
4. Physiologic optics, refraction, color vision
5. Diagnosis and therapy
6. Ocular motility
7. Conjunctiva, cornea, sclera
8. Uvea, sympathetic disease, aqueous
9. Glaucoma and ocular tension
10. Crystalline lens
11. Retina and vitreous
12. Optic nerve and chiasm
13. Neuro-ophthalmology
14. Eyeball, orbit, sinuses
15. Eyelids, lacrimal apparatus
16. Tumors
17. Injuries
18. Systemic disease and parasites
19. Congenital deformities, heredity
20. Hygiene, sociology, education, and history

1

ANATOMY, EMBRYOLOGY, AND COMPARATIVE OPHTHALMOLOGY

Wright, E. S. **A simple method of photomicrography.** Am. J. Ophth. **31**:611-612, May, 1948. (3 figures.)

2

GENERAL PATHOLOGY, BACTERIOLOGY, IMMUNOLOGY

Bocci, Georgio. **A rare bacteriologic finding: a bipolar germ recovered from palpebral vaccinia ulcers.** Boll. d'ocul. **26**: 561-569, Sept., 1947.

A farmer's wife, 34 years old, acquired from her vaccinated son vaccinia pustules on her right lower lid which were complicated later by an ulceration of her right bulbar conjunctiva. A germ was found in smears and isolated by culture in blood agar, characterized by negative Gram staining, deeper staining of the ends of the rods measuring from 0.5 to 1.5μ, lack of capsules, lack of spores, motility, rapid growth in pepton agar, pellicle formation on broth and, if not identical with, resembling the rare germ Malleomyces pseudomallei or Pfeifferella Whitmorei. The lesions healed under staphylococcus anatoxin treatment in ten weeks.

K. W. Ascher.

Grant, W. M. **Ocular injury due to sulfur dioxide. II. Experimental study and comparison with ocular effects of freezing.** Arch. Ophth. **38**:762-774, Dec., 1947.

Serious ocular injuries have occurred in the refrigeration industry from accidental contact with a jet of liquid sulfur dioxide. Experiments were conducted on the eyes of living rabbits to determine the cause of the severe damage. Freezing of the anterior portion of the eye for several seconds (by a nontoxic refrigerant) produced mild and transient disturbances. Lesions similar to those caused by liquid sulfur dioxide could be produced by several seconds' exposure to the pure gas at room temperature. It is concluded that the production of severe ocular injury by liquid sulfur dioxide is not due to freezing or to the formation of sulfuric acid, as has formerly been postulated, but is the result of its ready penetration of the corneal epithelium in high concentrations and its action, principally as sulfurous acid, in

denaturing corneal proteins, including enzymes. John C. Long.

Donegan, J. M., and Thomas, W. A. **Capillary fragility and cutaneous lymphatic flow in relation to systemic and retinal vascular manifestations: rutin therapy.** Am. J. Ophth. **31**:671-678, June, 1948. (3 figures, 11 references.)

Hoof, Doris. **Tissue research and cell culture of the cornea.** Am. J. Ophth. **31**:709-712, June, 1948. (2 figures, references.)

Maumenee, A. E., and Kornblueth, W. **Regeneration of the corneal stroma cells. I. Technique for destruction of corneal corpuscles by application of solidified (frozen) carbon dioxide.** Am. J. Ophth. **31**:699-702, June, 1948. (4 figures, 6 references.)

Rosso, S. **Crystalline antigens and anti-crystalline antibodies in the aqueous humor.** Ann. d'ocul. **181**:213-219, April, 1948.

The concentration of antibodies in the blood serum is tremendously greater than in the aqueous. Amorphous antibodies which have apparently not been studied as thoroughly as some other types are possibly a rather important factor in the genesis of cataract and some uveal diseases, such as endophthalmitis phaco-anaphylactica. Only alpha-globulins apparently have an antigenic action on the lens. The degree of antigen sensitivity has not been reported in studies of animals therapeutically treated for cataract. Intracapsular lens extraction is preferred in animal experimentation because lens masses affect the antigen and antibody composition of the aqueous. The preferred antigen and the grading of animal sensitiveness are discussed at some length. The aqueous of normal rabbits showed no complement change in seven of eight rabbits. Replaced aqueous, however, is clearly positive. In aphakic eyes the aqueous was also positive for 60 days after the beginning of the treatment. The blood serum of animals treated with crystalline proteins changed the complement in the presence of the same antigens employed in parenteral injections. In the normal eye the primary aqueous is not affected. In the secondary aqueous and in aphakic eyes the reaction is more active.

Chas. A. Bahn.

Sachs, E., and Larsen, R. L. **Cancer and the lens.** Am. J. Ophth. **31**:561-564, May, 1948. (10 references.)

Solis-Cohen, Myer. **The real removal of focal infection as the cause of ocular disorders.** Am. Practitioners **2**:576-579, May, 1948.

Focus of infection is bacterial, not structural, and is removed when the patient manufactures enough antibodies to destroy the organisms and neutralize the toxins. There is a frequent association of oral sepsis with ocular lesions. Tonsillectomy and sinusotomy do not remove the offending organisms. Most primary foci are in the upper respiratory tract. A properly cultured vaccine of proper dosage will contain endotoxins that will stimulate the production of bacterocidens.

Irwin E. Gaynon.

Woods, A. C., and Burky, E. L. **Studies in experimental ocular tuberculosis. The effect of promin and promizole in experimental ocular tuberculosis in the immune-allergic rabbit.** Tr. Am. Ophth. Soc. **45**: 170-183, 1947.

Both promin and promizole exert a deterrent action in the immune-allergic rabbit. The action of the two drugs is about equal. Histologic evidence of tuberculosis persists in the majority of the eyes of treated animals, but the lesions are much fewer and less severe than in con-

trol eyes. On transfer experiments with the extract of the uveal tract from the eyes of seven treated animals only one positive result was obtained. All controls gave positive transfer.

These results may be due either to a degradation or attenuation of the virulence of the organs allowing the resistance of the host to become more effective or to a direct bacteriocidal action on the bacilli.

David O. Harrington.

3

VEGETATIVE PHYSIOLOGY, BIOCHEMISTRY, PHARMACOLOGY, TOXICOLOGY

Bárány, Ernst. **The rate of equilibration of intraocular pressure.** Acta ophth. 25:175-187, 1947.

The purpose of this investigation was to ascertain how rapidly the intraocular pressure regains its equilibrium. In a study of the influence of blood pressure on the intraocular pressure it was found that the effect of a change of blood volume in the eye is of short duration; after it is over the real change in equilibrium level due to the factors influencing the formation and circulation of aqueous becomes manifest. Bárány points out that the studies of Wessely and Duke-Elder did not take into consideration the first transitory changes. The briefly reviewed data of experimental investigation on the period of equilibration leads to the fairly unanimous conclusion that the period of equilibration should lie between 5 and 15 minutes. Bárány's own investigations consisted of a series of experiments on rabbits' eyes. Thirty minutes after placing a van Leersum loop on the carotid the tension was measured. Slight pressure of a finger on the eye on the side of the closed carotid was applied through the lid for 6 to 7 minutes. After the pressure was removed tonometry was performed on each eye alternately, with one reading per minute until constant values had been obtained, which was no longer than 15 minutes. The result was a series of slowly falling pressures in the control eye, and pressures that rose quickly at first and then slowly in the massaged eye. The mathematical deductions for the time constant are given in detail. For rabbits the time constant is 6 to 8 minutes, if the carotid is closed, and somewhat less if it opens. This corresponds to an equilibration time of 12 to 24 minutes. Only after the lapse of this period, as a minimum, can one be certain that the intraocular pressure reflects the change in equilibrium level.

Ray K. Daily.

Bárány, Ernst. **The influence of local arterial pressure on aqueous humor and intraocular pressure.** Acta ophth. 25:189-193, 1947.

This is a report of an attempt to demonstrate the passive changes in the caliber of the uveal vessels produced by changes in blood pressure. Previous experiments of compression of the carotid with a van Leersum loop have shown that the local blood pressure is reduced to about one-third of its normal level immediately after closure of the carotid. On ophthalmoscopic examination a slight diminution in the caliber of the retinal and long ciliary arteries is seen, with no change in the veins. On the release of the carotid pressure there is a distinct increase of the arterial caliber, but none in the veins. The vessels observed in this study were the capillaries of the ciliary processes, which in the albino rabbit pass down the back of the iris and can be seen with the corneal microscope as a shadow through the iris. There was no change in the uveal capillaries. Reduction of the arterial blood pressure by occlusion of the carotid caused a distinct and prompt decrease in the caliber of the uveal arteries but no discernible change in the caliber of the choroidal veins, nor in the ciliary processes at the back of the iris. Bárány believes that passive vas-

cular changes play no role in protecting the intraocular pressure from the influence of blood pressure changes. Since the capillary blood pressure is low there can be no possibility of passive aqueous formation. Ray K. Daily.

Christini, C., and Cuisa, W. **Methylization of the lens: normal and cataractous.** Ann d'ocul. **180**:742-745, Dec., 1947.

In the metabolic reduction of the living protein molecule, methylization plays an apparently important part as one of the oxidoreductors. It also participates in the combustion of carbon with resulting CH_3 groups, and in lens metabolism. Cholin, methionine, and cysteine are involved as well as nicotinic acid and its amides, normally and especially in the diabetic. The methylization product of nicotinic acid (trigonelin) and that of nicotinic amide (trigonelin amide) were extracted from transparent beef lenses and cataractous human lenses. In cataractous lenses these products of methylization were absent, which is considered of importance.
Chas. A. Bahn.

Grignolo, Antonio. **Investigations concerning the possible interference between the bacteriostatic action of penicillin and the lytic action of the lacrimal lysozymes.** Boll. d'ocul. **26**:699-709, Nov., 1947.

In vitro experiments performed on liquid and on solid culture media showed no interference of the agents named in the title; micrococcus lysodeicticus, hemolytic streptococcus, and staphylococcus aureus were the germs examined. Two figures show the Petri dishes after 24 hours of incubation (bibliography.)
K. W. Ascher.

Huber, A. **The pharmacology of the blood-aqueous barrier.** Ophthalmologica **114**: 217-227 (Oct.-Nov.) 1947.

The rate of appearance of intravenously injected flourescein (2 cc. of a 10-percent aqueous solution of sodium-fluorescein) in the anterior chamber of human eyes has been extensively studied by Amsler and Huber (Ophthalmologica 111:155, 1945). Slitlamp examination permits fairly accurate in situ estimates of the fluorescein concentration in the aqueous. In normal human beings with normal eyes, the rate of appearance varies within fairly wide limits. There is, however, a high test-retest consistency in the same individual. The rate of the appearance of fluorescein in the anterior chamber may serve as a criterion of the permeability of the blood-aqueous barrier. In the paper under review Huber reports the effect upon the appearance of fluorescein in the anterior chamber of some of the commonly used ophthalmological drugs.

Atropine and homatropine are ineffective. Pilocarpine and eserine accelerate the appearance of fluorescein. Adrenaline injected subconjunctivally during the first 10 minutes delays and then slightly accelerates the entrance of fluorescein. In the discussion of this paper before the meeting of the Swiss Ophthalmological Society in 1946, F. P. Fischer states his preference for eosine injections as a permeability test. Eosine has the advantage of a very constant particle size upon injection into the blood stream whereas fluorescein occurs in several different particle sizes. Huber objects to the use of eosine because of its toxicity. The marked individual variations observed with fluorescein do not interfere with the latter's use in pharmacological studies since the individual's other (untreated) eye reliably serves as a control.
Peter C. Kronfeld.

Leoz de la Fuente, G. **Prostigmine in ophthalmology.** Arch. Soc. oftal. hispano-am. **8**:130-133, Feb., 1948.

The author concludes that oral or parenteral administration of prostigmine has no effect on the pupil of the normal or

glaucomatous eye. Instillation of 3-percent prostigmine bromide does not affect the tension of the normal eye, but in an eye with hypertension, the instillation produces a fall in ocular tension, and miosis, which reaches its maximum in 30 minutes after which the miosis diminishes. The fall in tension persists for a longer time, varying with the conditions of each individual eye. The hypotensive action is similar to that of ½-percent eserine, and is better tolerated. The instillation is painless and does not produce the undesirable general and local effects occasionally produced by eserine, nor an annoying spasm of accommodation. Ray K. Daily.

Matteuci, P. **The innervation of the ciliary muscle in man.** Ophthalmologica 114:377-383, Dec., 1947.

According to the theory of Cogan (Arch. of Ophth. 18:739, 1937), contraction of the radial fibers of the ciliary muscle causes accommodation of the eye for far while contraction of the circular portion causes accommodation for near. According to the same theory the radial portion is innervated by sympathetic fibers or adrenergically and the circular portion by the parasympathetic or cholinergically. The specific purpose of the paper under review is to compare histologically the innervation of the three portions of the ciliary muscle in man. A number of human eyes with malignant melanomas, but normal anterior segments became available for this work. The silver impregnation method of Gros was used to demonstrate nerve fibers and their ramifications in the ciliary muscle. All three divisions of the ciliary muscle were found to contain myelinated parasympathetic as well as nonmyelinated sympathetic fibers. "The theory of Cogan needs revising."

Peter C. Kronfeld.

Panzardi, Domenico. **Effect of pentothal anesthesia on corneal reflex, intraocular pressure, and pressure in the central retinal artery; possibilities of this new anesthetic in ocular surgery.** Boll. d'ocul. 26: 570-580, Sept., 1947.

In 18 patients, anesthetized with sodium pentothal, the corneal reflexes disappeared rapidly and remained absent during the whole anesthetic period. Only three out of these 18 lost their corneal reflexes slightly later. Intraocular pressure values were diminished by 5 to 12 mm. Hg and assumed normal values at the end of the anesthesia; the increase is usually slow and the preanesthetic figures are found when the anesthesia is over. In all but one case, the light reflexes of the pupils remained active although weaker than before the anesthesia; in one case, it took two hours for the light reflex to reappear. The pupillary diameter is diminished during the anesthesia; in two patients a slight initial mydriasis was observed. The pressure in the retinal artery is increased for between 5 and 25 grams during the anesthesia; the measurements were taken only after ocular surgery, therefore it cannot be said whether in the initial period an opposite change might have been present. In 17 out of 18 patients, the eyes remained in primary position during the whole period of anesthesia. The author does not advocate the use of sodium pentothal in cases suitable for local anesthesia; if however severe pain is anticipated and general anesthesia seems preferable, sodium pentothal should be used in eye surgery for its quick and comfortable application. K. W. Ascher.

Ruedemann, A. D., and Schneider, R. W. **Alteration in plasma proteins in various types of cataract.** Tr. Am. Ophth. Soc. 45:319-327, 1947.

Twenty-seven patients with lens vacuoles and ten controls were studied in detail with reference to measurements of total and fractional plasma proteins by the electrophoretic method of Tiselius. In

24 patients an absolute increase in the beta globulin fraction was found. Three patients showed a relative increase in beta globulin fraction. None of the controls showed a comparable plasma protein pattern. David O. Harrington.

4

PHYSIOLOGIC OPTICS, REFRACTION, COLOR VISION

Bertotto, E. V. **The stereophotogrammetric study of the anterior segment of the eye.** Am. J. Ophth. **31**:573-579, May, 1948. (8 figures.)

Campbell, D. A. **A comparison of dark adaptation with the psychological state in miners.** Brit. J. Ophth. **32**:225-226, April, 1948.

This paper presents a comparison of the results of two articles reported in this same journal. It was seen that the average threshold values of dark adaptation in persons with hysteria or anxiety neurosis and in malingerers are the same as in those with normal mentality, whereas they are higher in the manic depressive individual and in the dull and backward. In the control group of miners, the psychologically abnormal had a lower threshold than the normal, while in the certified cases of miners' nystagmus the rise in threshold in hysteria and anxiety neurosis was more marked in those without nystagmus. Thus there is no significant relationship between the psychological state and the threshold of dark adaptation. Orwyn H. Ellis.

Campbell, D. A., and Tonks, E. **A comparison of dark adaptation in miners with their nutritional state.** Brit. J. Ophth. **32**: 205-208, April, 1948.

A careful inquiry was made into the nutritional state of about 100 miners. Owing to the system of rationing there was no seasonal variation in the dietary content of vitamin A, nor in the choice of diet available. The blood levels of plasma carotene, vitamin A, and alkaline phosphatase and liver dysfunction, tested by the thymol turbidity method, were determined. The raised threshold for dark adaptation, which is a constant feature of all miners, was not due to a lack of vitamin A or D, nor to any obvious nutritional disturbance. Orwyn H. Ellis.

Crisp, W. H. **Errors in the practice of ocular refraction.** Rev. brasil. oftal. **6**:125-131, March, 1948.

After some historical considerations, the following points are emphasized: Hyperopia is usually undercorrected and need not be so. At least five out of six hyperopic patients can learn to use their full correction, with full use of their visual acuity, provided frame-fitting is perfect. The full trial-case measurement of hyperopia is always a slight overcorrection, because of the fact that rays of light forming a point at 4, 5, or 6 meters are divergent when they reach the patient's eye. The accurate myopic measurement at the trial case is a slight undercorrection, for the same reason. Eyestrain is frequently produced by undercorrection of myopia, because the patient resorts to various maneuvers to sharpen his vision. Accurate correction of either hyperopia or myopia is frequently impossible without exact correction of astigmatism and vice versa. Subjective tests for astigmatism are necessary and possess more accuracy and finality than the objective tests. The patient should be given his full visual acuity and not a supposed normal of acuity such as 20/20. Both eyes should be refracted with equal care and accuracy. W. H. Crisp.

Eames, T. H. **Comparison of eye conditions among 1,000 reading failures, 500 ophthalmic patients, and 150 unselected children.** Am. J. Ophth. **31**:713-717, June, 1948. (2 tables.)

Feldman, J. B. **Use of the telescopic amblyoscope in visual training for defective vision.** Arch. Ophth. **38**:494-505, Oct., 1947.

A telescopic amblyoscope is described which can be used for prognosis and for the training of defective vision in patients with ametropia of various intensities. Forty-seven patients with intractable ametropia were given reading lessons with this instrument once a week for twelve weeks. Prognosis may be determined by having the patient look through the telescopic amblyoscope at a test chart 6 meters away. Vision thus obtained, plus or minus one line, is the final vision to be expected after 12 lessons. The role of suppression in cases of amblyopia is discussed. A table is presented showing the number of patients, the number of lessons given, and the initial and terminal vision of each patient, as well as one that shows the refractive error and weekly progress in each of four cases. John C. Long.

Fillippi Gabardi, E. **Concerning contact lenses.** Rassegna ital. d'ottal. **17**:3-10, Jan.-Feb., 1948.

The history of contact lenses begins with Cartesio, who, in 1637, suggested placing in contact with the cornea a tube containing water and having a lens at the distal end. He established the fact that light was no longer refracted by the corneal surface but from the distal end of the tube. The aim was to obtain an enlargement of the image.

In 1827, Herschel attempted to correct the defect in the corneal curvature in keratoconus and irregular astigmatism by the use of a spherical lens with parallel faces. This was placed over the cornea, using the animal gelatine for the medium between lens and cornea. Antedating Herschel was Thomas Young's effort to correct astigmatism by Cartesio's method but he found that it gave insufficient enlargement of the image.

The more modern practice of using contact lenses made of glass dates from 1887 when Fick of Zürich, Kalt of Paris and Müller of Hamburg independently began this work. Constant efforts to improve the technique and material has brought us to the present state where 90 percent of patients can wear contact lenses from 8 to 18 hours daily.

E. M. Blake.

Halldén, Ulf. **Use of polarized light in scotometry with binocular fixation.** Brit. J. Ophth. **32**:186-188, March, 1948.

To obviate the universal difficulties of scotometry with monocular fixation of an eye with poor central vision, Halldén used polarized light. The screen is viewed with both eyes through polarized filters with the planes of polarization as right angles to each other. The test object is a spot of light which also shines through a filter which can be rotated to become invisible to either eye while the whole screen and fixation point are clearly visible to both eyes. The test object can be varied in size and color. The author uses a screen of aluminized sheet iron, and small permanent magnets as indicators.

Morris Kaplan.

Herzau, W. **Examination and measurement of discrepancies of ocular correspondence.** Klin. Monatsbl., f. Augenh. **112**:267-277, 1947.

Discrepancies of ocular correspondence may exist under natural conditions during asymmetric convergence, under certain artificial optical conditions as in corrected high anisometropia and, finally, under pathologic conditions involving asymmetry of the eyeballs. Determination of the horopter is not quite as exact as haploscopy with the eikenometer of Ames or the Trieder haploscope. Other methods include the metroscope of Tschermak which measures the appearance of equal distances and instruments which compare

double images. The author describes an instrument based on these two last mentioned principles. It consists of a central fixation point which is binocularly seen and of four movable illuminated arrows (two on each side, one above the other) which are seen monocularly by means of polarization. This instrument measures either the apparent equalization of distances or coincidence. (9 figures, references.) Max Hirschfelder.

Hwai-sze Fang, **Amplitude of ocular accommodation in Chinese.** Chinese M. J. **66**:32-34, Jan., 1948.

The accommodative power of 1,242 male Chinese subjects between 16 and 35 years of age was tested. It was found that the Chinese possess an amplitude of accommodation higher than that of Japanese but inferior to that of Americans and Germans. Irwin E. Gaynon.

Jaeger, A. **Limits of visual acuity.** Klin. Monatsbl. f. Augenh. **112**:244-251, 1947.

After referring to the fact that the visual acuity of the light adapted eye conforms to an angle of 60 arc seconds and that the diameter of the foveal cones corresponds to this finding the author discusses the limits of visual acuity of the dark adapted eye. At the threshold of visual acuity in the dark adapted eye he finds a fluctuation in the visual field and the test objects "come and go" to the observing eye. This fluctuation disturbs the full utilization of the stage of adaptation. It can be avoided if one does not use total darkness for such adaptation but light values which correspond in intensity to the subsequent test objects. More constant values for visual acuity in subdued light are found in this manner. Similarly, a slight diffuse illumination is brought about by the tapetum lucidum of many animals, and this apparently is the purpose of the tapetum lucidum in night vision. (References.) Max Hirschfelder.

Jonkers, G. H. **Objective adaptometry.** Ophthalmologica **114**:397-408, Dec., 1947.

Objective adaptometry is based on the elicitation of opticokinetic nystagmus by a pattern of white and black vertical stripes which move horizontally across the examinee's field of vision. The author has developed the method further by determining the most suitable dimensions of the pattern and the most suitable speed of its movement. He records the nystagmus by means of a cathode-ray-oscillograph with the electrodes placed against the skin overlying the temporal orbital rims. In a few trained examinees he obtained remarkably good agreement between subjective and objective tracings of the course of dark adaptation. "How far this method can be applied to clinical research I hope to be able to investigate further. In all probability, it (the method) is unfit for use in cases of unrest of the eyes. . . . The name 'objective adaptometry' may suggest a little too much."

Peter C. Kronfeld.

Krimsky, Emanuel. **Corneal light reflex in diagnosis of retinal correspondence.** Arch. Ophth. **38**:468-486, Oct., 1947.

The physiology of retinal correspondence is discussed. The use of the corneal light reflex as an aid to the measurement of squint and in the study of retinal correspondence is described. The position of corneal light reflexes should tell one whether retinal correspondence is normal or abnormal. Any method or apparatus which can produce clearcut corneal light reflexes that can be flexibly displaced is suitable for the study. The technique of testing with the rotary prism, the phorometric stereoscope, the anglometer, the synoptophore and the Maddox rod is discussed. The original article should be consulted for the detailed conclusions derived from the study of retinal correspondence. John C. Long.

Lenoir, M., and Rose, M. **Molded contact glasses.** Arch. d'ophth. **7**:604-608, 1947.

The authors review the history of molded contact lenses and describe in detail their technique for making molds of the eye as a preliminary to the fabrication of plastic contact lenses. They have definitely abandoned the use of preparations such as Negocoll, which require heat for melting, and work entirely with a plastic known as Perspex which can be used cold. The technique as outlined is complex and the authors believe it should be treated as a true ocular operation, and conducted with the same care. When properly done the mold will reproduce accurately all visible parts of the globe.

Phillips Thygeson.

Lo Cascio, G., and De Leonibus, F. **Experimental facts concerning intracapsular accommodation.** Boll. d'ocul., **26**: 609-629, Oct., 1947.

Emmetropic eyes of young people with more than normal visual acuity and accommodation of about 9 diopters were measured before and during accommodation, and the dioptric values of the crystalline lens, the position of the principal points, both in rest and in accommodation, were calculated. In one eye, the intracapsular accommodation was found to be 28.5 percent of the whole accommodative effort, in the second eye, it was 65 percent. (2 figures, 22 tables, references.)

K. W. Ascher.

Loutfallah, Michel. **The cross cylinder of Jackson.** Ann. d'ocul. **181**:136-147, March, 1948.

The history, description, theory and technique of this well-known adjunct to refraction are discussed in detail. The method is used to determine the best combination of sphere and cylinder to verify the strength of the cylindrical component, to localize the cylinder axis and to verify the spherical component.

Chas. A. Bahn.

Macnie, J. P. **Clinical aniseikonia.** Tr. Am. Ophth. Soc. **45**:229-240, 1947.

From a clinical and statistical study of cases fitted with iseikonic glasses the author concludes that no symptoms are characteristic of aniseikonia; that the presence of aniseikonia can not be anticipated on the basis of anisometropia or the magnitude of the refractive error; that it is not possible to anticipate whether the correction of aniseikonia will aid the individual and that iseikonic lenses should be used only for the relief of symptoms and then only after the failure of the usual ocular therapeutic measures to give relief.

David O. Harrington.

Miles, P. W. **A comparison of aniseikonic test instruments and prolonged induction of artificial aniseikonia.** Am. J. Ophth. **31**:687-696, June, 1948. (5 figures, 9 references.)

Osborne, E. S. **Nature's disturbances and cures in ophthalmology.** J. M. A. Georgia **37**:142-144, April, 1948.

Most of the asthenopia caused by illuminants are traced to those of short-wave lengths. Yellow-green wave lengths cause the least eye fatigue. Dark glasses, tinted lenses, dim lights and poor illumination stimulate rod vision but fails to stimulate and activate cone vision.

Irwin E. Gaynon.

Raphael Sebas, S. **Cross cylinder.** Rev. brasil. oftal. **6**:173-177, March, 1948.

This brief article emphasizes especially the following points: a normal eye, or one rendered emmetropic by spectacle lens, will have its visual acuity disturbed if a Jackson cross cylinder is placed before it in any position. Self-observation of the effects of the cross cylinder is of great

utility to the oculist because it illustrates what passes through the mind of the patient when subjected to these tests.

W. H. Crisp.

Sharpley, F. W. **The dark adaptation of coal miners suffering from nystagmus.** Brit. J. Opth. **32**:199-204, April, 1948.

Dark adaptation tests were made under strictly controlled conditions, not only on miners who were obviously suffering from nystagmus, but on miners who were not and also on completely normal men in other occupations. The final rod threshold value only was measured with a series of short flashes. The continuous increase in the threshold value with age in normal subjects was very evident. It was noted that the threshold value in all miners, with or without evidence of the disease, was substantially higher than in the normal group. Orwyn H. Ellis.

Tower, Paul. **Contact lenses for correction of myopia complicated by lesions of the retina and choroid.** Arch. Ophth. **38**: 521-528, Oct., 1947.

Contact lenses were prescribed in 30 cases of myopia with degenerative conditions of the fundus of the eye. The data on 12 cases presenting more pronounced pathologic changes are presented, 4 of which are described in detail. In each case vision was greatly improved as to clarity and detail of objects perceived.

The reasons for the improvement of vision through the use of contact lenses are discussed. The increase in the size of the retinal image is approximately 20 percent in the case of a minus 10.00 lens. The average wearing time for the contact lenses was seven hours. John C. Long.

v. Tschermak-Seysenegg, A. **Binoculars with different image size (aniseiconic binoculars).** Klin. Monatsbl. f. Augenh. **112**:277-279, 1947.

A quick change of magnification in a binocular is sometimes desirable to enable an observer of wild life or an airplane spotter to identify certain details. The construction and application of aniseiconic binoculars for comparing moving images in different magnification is described. An auxiliary lens attachment is suggested which changes the magnification in one of the tubes of the binocular sufficiently to create a noticeable size difference in haploscopic vision.

Max Hirschfelder.

Valière-Vialeix. **The stenopaic slit: its clinical applications and technique.** Ann. d'ocul. **180**:721-741, Dec., 1947.

Generally speaking, vision is improved by the stenopaic slit in abnormalities due to defective light transmission, but not improved in defects of perceptive origin. Acquired diffuse lesions, such as corneal edema and vitreous opacities, are exceptions to this statement. Regular, refractive errors, irregular ones as in conical cornea, and lens opacities are included in the first group. Visual defects due to inflammatory or degenerative lesions of the uvea, retina or optic nerve form the second group. If the visual defect is essentially optical and focal, a supplementary smaller pupil which facilitates marginal sharpness of more diffuse retinal images will tend to improve vision. The more transparent media are used to the greatest optical advantage. Thus in a patient with a partial senile cortical cataract and the sequellae of uveitis, that part of the visual loss due to the former would probably be improved by the stenopaic slit, but the sight loss due to the uveitis would not be improved. The optical principles involved and the technique of its use are discussed at some length. Chas. A. Bahn.

5

DIAGNOSIS AND THERAPY

Amsler, M. **Qualitative examination of the function of the macula.** Ophthalmologica **114**:248-261, Oct.-Nov., 1947.

For the quick qualitative examination of the central portion of the visual field the author recommends a black screen ruled with white ink in squares, which at the distance of 28 cm. subtend an angle of one degree. At this distance the whole screen represents a square measuring 20 degrees in width and height. The center is marked by a white spot. To facilitate central fixation in cases of absolute central scotoma the diagonals are also traced out in white. The subject who looks at the screen monocularly is asked the following six questions: (1) Do you see the white spot in the center of the square? (2) Keeping your eye on the white spot (or on the intersection of the diagonals) do you see the four corners of the big square? Do you see the four sides? Do you see the entire square? (3) Keeping your eye on the white spot, do you see a regular system of small squares? Or do you notice interruptions, spots or blotches disturbing the regular arrangement of squares? Is the latter veiled or blurred in spots? Where are these spots? (4) Keeping your eye on the central white spot, do you see the white lines of the square pattern in their proper relationship, that is parallel or at right angles to each other? (5) Aside from spots or deformities do you see any other irregularities, any movement, vibration or discoloration of any of the lines? (6) Where do you see those spots or deformities? How many little squares are there between the spot and the center of the field?

The method described here is essentially that of survey perimetry ("Uebersichts-perimetrie," of Salzer [Internat. Congress, Amsterdam, 1929 and Klin. Monatsbl. f. Aug. 85:34, 1930]). It is very generally used for quick orientation before the quantitative campimetry.

Peter C. Kronfeld.

Arruga, H. **Formalin sterilization in daily practice.** Arch. Soc. oftal. hispano-am. **8**:134-136, Feb., 1948.

Arruga keeps his instrument sterile in metal or glass containers in which he places a tablet of formalin. Bacteriologic studies demonstrated the effectiveness of this method of sterilization. The illustrations show a tonometer, diathermy handles, lacrimal probes, sutures, and syringes in their containers. (9 illustrations.) Ray K. Daily.

Bell, A. E. **A modified erisophake.** Am. J. Ophth. **31**:610, May, 1948. (1 figure.)

Bruens, E. **The visible influence of concentrated sulfonamid instillations on the tissues of infants in gonorrheal ophthalmia.** Klin. Monatsbl. f. Augenh. **112**:251-255, 1947.

Solutions of 10 to 30 percent Albucid and 10 to 20 percent Cibazol were used in hourly and half hourly intervals. Aside from the therapeutic effect on the gonococci such concentrated solutions are at the same time irritating to the eye. Increased redness of the lid margin, edema of the lids, possible damage to the corneal epithelium and pain are cited as proof. A bluish-red discoloration of the conjunctiva is often found in the healing stage of the disease. This may be due to the removal of the pathogenic organisms or to a toxic vasoconstrictor effect of the sulfonamides. The author now uses 15 percent Albucid and 15 to 20 per cent Cibazol solutions. Max Hirschfelder.

Chamlin, Max. **Recording of visual fields.** Am. J. Ophth. **31**:565-573, May, 1948. (7 figures, 11 references.)

Doggart, J. H. **Slit-lamp microscopy.** Brit. J. Ophth. **32**:232-246, April, 1948.

The author discussed the history of the development of the slitlamp and corneal microscope. He notes the many advantages of its use, especially the diagnosis of different forms of lens change, and of metal impregnation of certain structures of the eye. The types of pigment changes

and depositions of the cornea and lens are described. The instrument has proved to be of inestimable value, although early ophthalmologists were sceptical as to its worth. Orwyn H. Ellis.

Dufour, R. **Modern methods of localization of intraocular foreign bodies.** Ophthalmologica **114**:298-303, Oct.-Nov., 1947.

The author recommends the method of Goldmann and Bangerter which consists of roentgenographic localization of the foreign body with reference to a metal ring attached to the cornea by means of tiny hooks (Ophthalmologica 107:75, 1944). The advantages of this method are that the plane of reference, the ring, cannot slip and that incorrect position of the globe during the taking of the picture can be recognized by distortion of the ring in the X-ray picture. The author has worked out a diagram to make the best possible use of this simple roentgenographic method. Peter C. Kronfeld.

Esteban, Mario. **Fluoroscopy for diagnosis and localization of intraocular foreign bodies.** Arch. Soc. oftal. hispano-am. 7:1038-1090, Nov., 1947.

The author has used fluoroscopy instead of X-ray pictures for diagnosis and localization of intraocular foreign bodies with good results. He uses the Ritter unit used in dental work and describes his technique. He hopes that this procedure can be combined with the magnet for the extraction of foreign bodies imbedded in the posterior segment of the eye.

J. Wesley McKinney.

Huber, A. **The Tyndall phenomenon in the anterior chamber.** Ophthalmologica **114**:228-241, Oct.-Nov., 1947.

The author describes a photometric attachment to the slit-lamp of Haag-Streit which permits accurate measurement of the intensity of the light beam in the anterior chamber, and thus permits accurate quantitative studies of inflammatory processes of the anterior segment of the eye. The incident light is divided into a main portion which enters the eye in the usual fashion and produces the Tyndall phenomenon in the anterior chamber. The other portion of incident light is deviated into an optical system that reduces and accurately measures its intensity and a clever optical device permits direct comparison with the Tyndall phenomenon produced by the main portion of the incident light. In the discussion Goldmann describes a similar apparatus. The colloidomeder of Roenne, an attachment to the slitlamp of Zeiss intended for the same purpose (see Kronfeld, Am. J. Ophth. 24, January, 1941), has apparently not stood the test.

Peter C. Kronfeld.

Hylkema, B. S. **An eye speculum with different blades for upper and lower lids.** Brit. J. Ophth. **32**:184-186, March, 1948.

Since the two lids are entirely different both anatomically and functionally, it seemed to the author that the specula with two similar blades could be improved considerably. Simple retraction of the lower lid by the ordinary specula is all that is necessary; on the other hand, the upper lid must be pushed back into the orbit and elevated away from the eye against the upper rim of the orbit. In the new speculum, the lower retractor is a blade formed as a simple hook while the upper retractor possesses an arch which is parallel to the surface of the bulb. The two blades are interchangeable on the speculum for the right and left eyes. The use of the wire speculum is deplored.

Morris Kaplan.

Kelly, T. S. B. **A note on intra-vitreous penicillin.** Brit. J. Ophth. **32**:153-160, March, 1948.

The cases here treated with intravitre-

ous penicillin were roughly divided into four groups: prophylactic, post-traumatic vitreous infection, postoperative vitreous infection and vitreous infection of unknown origin. Nine cases are described in this series, in six of which an eye was enucleated mostly as a prophylaxis against sympathetic ophthalmia and not as a result of progress of infection. However, since it could be assumed that all nine eyes would have ordinarily been removed, the treatment is considered unquestionably beneficial. Routinely a retrobulbar injection of novocaine and adrenalin is given; then, in the traumatic lesions, through the wound of entry one or two thousand units of pure penicillin in 0.1 or 0.2 cc. of distilled water is injected into the vitreous. Where there is no wound, the drug is injected with a tuberculin syringe about 8 mm. back of the limbus, and the needle is inserted no more than 5 mm. The author feels that chance of benefit makes the injection worthwhile in prophylaxis of all wounds and suggests that is is also useful in longstanding uveitis. He also uses it in doses of 100 to 200 units per cc. as a routine prophylaxis in vitreous transplants. Morris Kaplan.

Knapp, A. A. **The time for eye surgery.** New York Medicine **4**:16-19, March 20, 1948.

Surgery may be performed any time from the first few weeks of life to the last. Complicating systemic diseases need not cause the eye surgeon to delay. Cataract surgery should be performed as early as is necessary to give the patient the vision required for his occupation. The two stage operation with preliminary iridectomy is the safer method. Glaucoma surgery should not be delayed after medical treatment has been found to be ineffective. The patient that has glaucoma should be prepared for surgery psychologically early in the course of his disease. The surgery of detached retina and strabismus and traumatic and plastic surgery of the eye are discussed.

H. C. Weinberg.

Knipfer, A. **Late results of Roentgentherapy in hemorrhagic glaucoma.** Boll. d'ocul. **26**:644-654, Oct., 1947.

Eyes irradiated for treatment of hemorrhagic glaucoma during the years 1937-1945, were reviewed after an interval of two to ten years. Among 41 patients, 19 could not be studied long enough but they had a tolerable relief of pain when seen last; eleven patients had a good result, two were improved, and in nine, no effect could be ascertained. The action of the X rays is to be understood as a) relief of spasm in the thrombosed vessels, hyperemia and improved circulation, possibly even recanaliculisation; b) reabsorption of the effused blood; c) restriction of the transudation inside the eyeball; d) analgesic action. In successful cases no new hemorrhages occurred, and the retinal vessels showed a certain degree of healing. Failures are ascribed to inadequate technique, mostly overdosage, insufficient duration of treatment, and the nature of the underlying disease such as arteriosclerosis, hypertension, diabetes, or menopausal vascular crisis. Early treatment is necessary; not more than 80 r should be given per session, in highly irritated eyes even only 40 r; three to five applications should be given over a period of two to three weeks, particularly if some vision is left and in more resistant cases, after an interval of two to four weeks, another series of three or four applications is indicated. (More than 50 references.) K. W. Ascher.

Koke, M. P. **A review of common ocular problems in children.** California Med. **68**:370-373, May, 1948.

The author presents a comprehensive review of the common ocular problems

in children. Of 2,432 ocular problems 51 percent were refractive errors, 11 percent were muscular abnormalities, and 35 percent were due to external disease. In the list of congenital abnormalities two cases of retrolental fibroplasia were seen and four of toxoplasmosis. The author recommends the dilatation of all infants' pupils during the first office visit.

O. H. Ellis.

Kornerup, Tore. **An investigation, in successively variable monochromatic light of vessels of the human eye in diseased conditions.** Acta ophth. Suppl. 28, 1947, pp. 1-117.

The author examines the vessels of the eye with the use of monochromatic light. The light source is a carbon arc. The light is thrown on a dispersing system, the monochromator, the essential part of which is a constant deviation prism designed by Pellin and Broca. The prism can be rotated to bring different parts of the spectrum before a slit which cuts off all light but a certain wave length which can be read on a scale.

On observing the retinal vessels with a wave length of about 575mμ the vessels are distinctly seen. However, if the prism is slowly rotated to bring the longer wave length of the spectrum before the slit, at a certain wave length the vessels disappear because they assume the same color as the surrounding tissues. This wave length is noted and is called the L value (L for long). If the prism is now rotated back so that rays of shorter wave length are projected upon the slit, there will appear a wave length at which the retinal arteries of medium or finer caliber just become visible, this is the K value (K for short). The arithmetical mean between L and K value is the LK value.

It was found that the veins have a higher LK value than the arteries, thus in a pericorneal injection the arteries can be distinguished from the veins. If the LK value of the pericorneal injection showed a steady decrease, the course of a disease, such as iritis, scleritis, or keratitis was favorable, if, however, the LK value increased, the disease progressed to deterioration. The variations in the LK values are probably associated with variations in the percentage saturation of oxygen in the examined area.

The author also determined the LK value of the normal arteries. The pathologic arteries had a lower LK value and thus the author was able to detect a pathologic change in the arteries earlier than it was possible to recognize with the ophthalmoscope. In diabetes the LK value revealed pathologic changes in the retinal arteries in 60 percent of eyes which on ophthalmoscopic examination appeared normal. The assumption of many authors that the arteries in diabetes are normal is thus contradicted. The retinal hemorrhages seen in some cases of diabetes are in the majority of cases of venous origin. R. Grunfeld.

Mata López, Pedro. **Penicillin of retarded elimination in ophthalmology.** Arch. Soc. oftal. hispano-am. **7**:1111-1120, Nov., 1947.

For the past year the author has been using penicillin in sesame oil and bees' wax. Doses of 50,000 and 100,000 units per cc. were administered daily by injection. By this means he avoids the inconvenience of giving repeated intramuscular injections or frequent local applications of this drug. The therapeutic effects in ocular infections were found to be the same as those of an aqueous solution of penicillin. J. Wesley McKinney.

Morón Salas, José. **A new gonioscope.** Arch. Soc. oftal. hispano-am. **8**:149-159, Feb., 1948.

Morón Salas designed a new gonioscopy lens, which when placed on the eye permits inspection of the entire angle, with-

out the necessity of rotating the lens, as with the Goldman and Allen lenses. The technic for using the lens is described in detail. (16 illustrations.) Ray K. Daily.

Pelayo y Martín del Hierro, M. **Citrin or vitamin P in ophthalmology.** Arch. Soc. oftal. hispano-am. **7**:1129-1140, Nov., 1947.

Vitamin P has been found to be effective in the treatment of capillary fragility and permeability. The author has successfully treated postoperative hemorrhage following cataract extractions, dacryocystorhinostomy and plastic surgery of the lids. Citrin is administered by mouth, intramuscularly and intravenously in doses of 7½ grains or more per day with no toxic effects. J. Wesley McKinney.

Posner, Adolph. **A simplified tangent-screen technique using a pantograph attachment.** Am. J. Ophth. **31**:728-729, June, 1948. (1 figure.)

Streiff, E. B. **Plastic operations.** Ophthalmologica **114**:294-298, Oct.-Nov., 1947.

After some general remarks about plastic techniques used in the Eye Department of the University of Lausanne (Switzerland), the author describes two specific operations: (1) a tarsorrhaphy just temporal to the lacrimal puncta for the correction of lagophthalmos and ptosis of the lower lid after facial nerve palsy, and (2) the repair, by means of a sliding skin graft, of a hole in the nasal orbital wall after exenteration for orbital malignancy. Peter C. Kronfeld.

6

OCULAR MOTILITY

Campbell, D. A., Harrison, R., and Vertigen, J. **Binocular vision in miners.** Brit. J. Ophth. **32**:226-232, April, 1948.

The binocular vision in full light adaptation and in full dark adaptation of miners with nystagmus was compared with that of a large group of miners of the same age. It was noted that in all men the subjective angle tends to become convergent when they are dark adapted. The majority of miners showed an abnormal fixation in that their eyes tended to look upwards. All miners were found to have a lower percentage of stereoscopic vision than other men, and those with nystagmus only occasionally were found to have stereoscopic vision.

The power of adduction did not vary with illumination. Miners who had good stereoscopic vision had a noticeably greater power of adduction than normal. As would be expected, miners of all types who had poor stereoscopic vision had little power of duction. Orwyn H. Ellis.

Healy, Electra. **Treatment of phorias in adults.** Am. J. Ophth. **31**:703-708, June, 1948.

Hilgartner, H. L. **Paralysis of superior rectus and inferior oblique from diabetes mellitus.** Am. J. Ophth. **31**:608-609, May, 1948. (3 figures.)

Kirby, D. B. **Surgery of strabismus.** Rev. brasil. oftal. **6**:135-142, March, 1948.

The necessary surgery may properly be executed at an early age. The operation should be rather such as will require supplemental surgery than one whose excess will have to be corrected later. Various surgical details are reviewed with respect to the more usual as well as the rarer types of case. Use of a routine technique is not advisable, but the process should be adapted to the individual.

W. H. Crisp.

Marín Amat. **A new technic for muscle shortening in strabismus.** Arch. Soc. oftal. hispano-am. **8**:143-148, Feb., 1948.

This technique eliminates the use of a muscle clamp, and secures the reattachment of the muscle to its original insertion by looping the muscle. The steps of the

operations are as follows: an elliptical piece of conjunctiva is excised over the muscle, the conjunctiva and Tenon's capsule are undermined, the muscle is stretched on two muscle hooks, pulling in opposite directions and a fixation suture is introduced through the tendon, which is cut in front of the suture. The three reattachment sutures of 00 silk pass through the distal lip of the conjunctiva and the capsule of Tenon, loop the muscle, pierce the episclera at the original insertion, and come out through the proximal lip of the conjunctiva. (6 illustrations.)

Ray K. Daily.

McGillivray, James. **Vertical deviations.** Canad. M. A. J. **56**:361-365, April, 1948.

Vertical deviations are classified as those which occur in infancy and usually are paretic in origin and those which occur in children over one year of age. The patients in the first group usually have false projection, amblyopia or suppression. The others usually have a certain degree of fusion, and usually can obtain single binocular vision. The functional anatomy of the vertical muscles is reviewed.

Failure to obtain single binocular vision denotes an incurable vertical deviation but a good cosmetic result with useful vision may be obtained by the use of surgery and orthoptics. The operation of choice often is that performed on the inferior oblique. Early refraction, prompt occlusion, and preventive measures are advised to help prevent false projection or amblyopia from developing. (15 figures.)

H. C. Weinberg.

Meacham, C. T. **A screen for prism cover test.** Am. J. Ophth. **31**:610, May, 1948.

Motto, M. P. **Practical surgical points in strabismus.** Ohio St. M. J. **44**:465-468, May, 1948.

Surgery should be performed before the sixth year. If the refractive error is small, operation may be performed earlier. Overacting internal rectus muscles require recession, underacting external rectus muscles require resection but never more than three millimeters. Refraction should be done several months after surgery.

Irwin E. Gaynon.

Rintelen, F. **Disturbance of conjugate gaze.** Ophthalmologica **114**:325-331, Oct.-Nov., 1947.

The author describes an unusual disturbance of ocular motility in a bricklayer, 27 years of age, who, one year after a fall from a height of 15 feet, complained of blurred distance vision and diplopia. The immediate effects of the fall had been an extensive scalp wound without bone injury, unconsciousness for a few minutes and a mild retrograde amnesia. Ophthalmologic examination two years after the accident revealed (1) ciliary spasm (amount not stated), (2) spasm of convergence causing a constant non-paralytic esotropia of 20 prism diopters for distance, (3) fixation of both pupils in extreme lateral version, (4) horizontal jerk nystagmus in monocular excursions regardless of their direction, (5) a peculiar disturbance of lateral gaze and convergence, characterized by jerky, "reluctant" performance of the internal rectus muscles and normal, smooth performance of the external. Similar ocular motor disturbances have been observed in cases of postencephalitic Parkinsonism in which the basal ganglia and specifically the globus pallidus and the substantia nigra are involved. By analogy, the author assumes a traumatic lesion of the basal ganglia as the basis of the various motor symptoms exhibited by his patient.

Peter C. Kronfeld.

Sala, C., and Pozzan, A. **The latent asymmetry from galvanic stimulation re-**

vealed by the optokinetic nystagmus. Riv. oto-neuro-oftal. **22**:263-271, July-Aug., 1947.

A number of normal individuals were studied to determine whether the optokinetic nystagmus could reveal a latent asymmetry of the vestibular nuclei in galvanic stimulation. After the number of the nystagmust jerks in the horizontal plane was established the latent asymmetry produced in the vestibular nuclei was recognized by noting that the nystagmus jerks were more frequent in one direction than the other. (Bibliography.)

Melchiore Lombardo.

Scobee, R. G., and Green, E. L. **Size of line in the Maddox-rod test.** Am. J. Ophth. **31**:697-699, June, 1948. (1 table.)

Weber, E. **Esotropia with diplopia in myopes.** Ophthalmologica **114**:320-324, Oct.-Nov., 1947.

In 1922 Bielschowsky described a peculiar disturbance of coordination that occurred in myopes and was characterized subjectively by diplopia of gradual onset and present only in distant vision. The objective findings were comitant esophoria and intermittent esotropia at distance only, with normal excursions and without any perceptible paralytic component. The condition which many Americans would describe as divergence insufficiency differs from divergence paralysis in that the onset is gradual, in contradistinction to the sudden development of divergence paralysis.

Two cases of such divergence insufficiency in myopes are described in detail. The treatment consisted of prisms incorporated in the distance correction. The results of the treatment are not stated.

Peter C. Kronfeld.

Weekers, L. **Monocular operation for high divergent strabismus.** Am. J. Ophth. **31**:541-544, May, 1948. (10 figures.)

7

CONJUNCTIVA, CORNEA, SCLERA

Amsler, M. **Keratographic observations of corneal transplants.** Ann. d'ocul. **180**: 746-748, Dec., 1947.

Two series of corneal photographs are presented in which the image of the Placido disc is reflected. In one series the reflection is irregular because the corneal transplant surface is optically perfect whereas in the other the reflecting surface is normal. Unexplained poor vision in some corneal transplants may thus be better understood. Chas. A. Bahn.

Atkinson, W. S. **Delayed mustard gas keratitis (dichlorodiethyl sulfide). A report of two cases.** Tr. Am. Ophth. Soc. **45**:81-92, 1947.

The signs and symptoms of delayed gas keratitis are reviewed and two cases with illustrative photographs are presented. Recognition of this condition is important in order to establish the service connection of the disability.

David O. Harrington.

Bischler, V. **A case of congenital sclerocorneal cyst.** Ophthalmologica **114**:371-376, Oct.-Nov., 1947.

A congenital small intrascleral cyst in the 9-o'clock position near the limbus with large secondary extension into the stroma of the inferotemporal quadrant of the cornea was treated successfully by aspiration and removal of the anterior wall of the scleral portion. With the disappearance of the corneal extension pocket the cornea cleared and the vision improved to 20/20 with a smaller astigmatic correction than before the operation.

Peter C. Kronfeld.

Bourquin, J. B. **Eosinophilia in the conjunctiva and in the blood.** Ophthalmologica **114**:203-216, Oct.-Nov., 1947.

Scrapings from the normal human con-

junctiva contain no eosinophile leukocytes even in the presence of high degrees of eosinophilia in the patient's blood. The conjunctival eosinophilia is a characteristic sign of allergic conjunctivitis of which the author gives a detailed clinical and histopathologic description. The subjective symptoms (itching and pricking sensations) are out of proportion to the objective findings (slight hyperemia, epithelial and lymphoid hypertrophy, swelling of the preauricular gland). In contra-distinction to vernal catarrh "simple" allergic conjunctivitis is characterized clinically by transparency of the conjunctiva, and histologically by the absence of fibrotic changes in the stroma. Eosinophilia in the conjunctiva, as well as in the blood, is characteristic of both conditions. Antihistaminic drugs are effective in both conditions. No mention is made of any effort to determine the specific offending allergen. Peter C. Kronfeld.

Bowes, C. F. **The use of anti-allergic drugs in the treatment of phlyctenular ophthalmia.** Brit. J. Ophth. **32**:163-164, March, 1948.

In 15 children who had phlyctenular disease, a positive Mantoux reaction and positive X-ray evidence of tuberculous infection, benadryl and antistin were used. Benadryl was given as elixir and antistin as tablet. Divided doses, increasing with time, were given and none of the expected side actions of benadryl were noted but some drowsiness was present with the antistin. No appreciable beneficial effects could be found. Morris Kaplan.

Buerki, E. **A new method for the preservation of corneal tissue.** Ophthalmologica **114**:288-293, Oct.-Nov., 1947.

Pieces of cadaver cornea are more easily available than whole corneas or eyeballs. The methods which are now in use for the preservation of whole eyeballs (storage in serum, whole blood or in a moist chamber, at 4 to 6 degrees centigrade) are not applicable to the excised cornea, which swells and becomes cloudy under these conditions. The author discovered that the excised cornea remains perfectly clear and retains its normal metabolic characteristics if stored in liquid paraffin at 6 degrees centigrade. Pieces of rabbit cornea stored in liquid paraffin for eight days were used successfully for transplantation and remained clear for a year. The new method has proved successful in one human eye. The oil adherent to the donor cornea is carefully removed by means of filter paper and the graft placed on a gauze sponge moistened with saline until its "bed" has been made ready. Peter C. Kronfeld.

Bursaux, M. **A case of conjunctivitis petrificans.** Ann. d'ocul. **180**:749-757, Dec., 1947.

Small pearly concretions were discharged from the conjunctiva of the right eye at about two week intervals in an 11-year-old girl. The eye became red and painful preceding attacks, but between them was almost normal. The number discharged in an attack varied from one to six and the size ranged from that of a pin head to a grain of rice. The concretions were white, dry, friable and irregularly crystalline. Chemically they were found to be calcium phosphate. Somewhat similar concretions were observed in the urine. Otherwise bodily examinations were normal. Conjunctivitis petrificans is believed to be due to a bodily alkalinosis with a tendency to precipitation in predisposed tissues. Because of the increased alkalinity of the tears, the conjunctiva is a frequent location. The concretions apparently become an irritant and the resulting vasomotor reaction aids in their expulsion.
Chas. A. Bahn.

Dean Guelbenzu, Manuel. **An operation for pterygium which eliminates recur-**

rence. Arch. Soc. oftal. hispano-am. **8**:137-142, Feb., 1948.

The well illustrated technic, which was used without a recurrence in 117 cases, is as follows: the head of the pterygium, including the invaded superficial corneal layers is dissected with a sharp knife, beginning in clear cornea. Two incisions, parallel to the pterygium, are made with scissors in the healthy conjunctiva as far as the internal canthus, the pterygium is excised with scissors by two slightly convergent cuts at the internal canthus, leaving a rhomboidal raw surface, and all episcleral tissue is thoroughly removed from this surface. Two triangular conjunctival flaps are fashioned above and below and brought down to cover the raw area, with the superior triangle adjacent to the limbus and the inferior behind it. The flaps are anchored by one suture to the episclera and the conjunctival wounds closed with two rows of vertical sutures. A small piece of conjunctiva is excised adjacent to the limbus to leave a small area of sclera uncovered. (12 illustrations.) Ray K. Daily.

Franklin, H. C. **Penicillin in drops for prophylaxis against ophthalmia neonatorum: a single instillation method.** South. M. J. **41**:320-325, April, 1948.

Almost 1200 infants were studied in the nursery and home during the first two weeks of life, as to the effectiveness of one instillation of penicillin for prophylaxis against ophthalmia neonatorum. It was found that 1.1 percent had pus in the eyes while in the nursery. Twice as many had pus in a previous series wherein penicillin had been given in four doses, and about six times as many have been previously reported after the routine use of silver nitrate.

The crystalline sodium salt was used, 2,500 units per cc. in sterile isotonic sodium chloride. The solution was kept refrigerated constantly, it was never out of the refrigerator for more than five minutes at any time, and was made fresh every five days. The sodium chloride was autoclaved twice weekly. The lids of the infant were wiped with sterile cotton, the eyes were irrigated with sodium chloride solution and then four drops of penicillin were put into each eye. Any pus was carefully noted and cultured. (2 figures, 4 tables, 1 chart, discussion, references.)

Bennett W. Muir.

Franklin, H. C., and Loeb, L. N. **Bacterial flora in eyes of newborn infants during first forty hours of life after single instillation of penicillin and silver nitrate.** J. Pediat. **32**:251-256, March, 1948.

The bacterial flora in the eyes of 200 infants was studied during the first 48 hours of life. In 100 a single instillation of penicillin had been used for prophylaxis and in the others a single instillation of silver nitrate. The number of positive cultures was slightly less after penicillin prophylaxis (41 percent) than after silver nitrate (45 percent). That anaerobic organisms are encountered in the conjunctiva only during the first hours of life is to be expected. The oxygen tension in the conjunctival sac produces conditions unsuitable for growth.

This study indicates that a single instillation of penicillin compares favorably with silver nitrate as a prophylactic agent. In this series penicillin was slightly better than silver nitrate in depressing the bacterial flora of the newborn conjunctiva during the first 40 hours of life. Further study is required for interpretation of the observed increase of the bacterial flora with time in the conjunctiva of the newborn infant. Theodore M. Shapira.

Grignolo, A., and Bruna, F. **Importance of penicillin in the treatment of septic corneal ulcers.** Boll. d'ocul. **26**:630-643, Oct., 1947.

Forty-eight patients of the Rome Eye

Clinic were treated for pneumococcic corneal ulcer with penicillin in drops, ointments, baths, subconjunctival injections, injections into the anterior chamber, and application as powder, to ascertain the most efficacious way of administration. Eye drops and ointments were sufficient in mild cases only; for more advanced ulcers, penicillin in substance was better, but in some cases, even the most aggressive therapy was helpless. Among 17 slight ulcers, only one did not respond to the treatment; among 15 of medium gravity, three remained uncured, and among 16 severe ulcers, 11 were failures. (5 tables, 27 references.) K. W. Ascher.

Hallermann, W. **The question of the intrauterine origin of the brown saucer-shaped lens opacity in congenital lues.** Klin. Monatsbl. f. Augenh. **112**:222-225, 1947.

A woman with old interstitial keratitis and luetic choroiditis exhibited a brown saucer-shaped opacity in the region of the posterior external embryonal lens nucleus. The border of the nucleus was seen as a fine line behind this opacity. The author concludes that this opacity was formed during intrauterine development of the lens and was a direct result of the lues in the mother. Max Hirschfelder.

Hilgartner, H. L., Wilson, R. T., and Wilson, J. D. **Surgical treatment of pterygia followed by X-ray therapy to prevent recurrence.** Am. J. Ophth. **31**:667-670, June, 1948. (1 colored plate, 1 figure, references.)

Kant, Alfred. **An unusual case of leptothricosis conjunctivae.** Am. J. Ophth. **31**: 607-608, May, 1948.

Larsen, Victor. **Luetic keratitis caused by an operation.** Acta ophth. **25**:195-199, 1947.

To clarify the role of trauma in the development of interstitial keratitis, Larson reports a case occurring several days after the extraction of a congenital cataract in a woman, 32 years old. It was then discovered serologically that she had congenital lues. She gave a history of poor vision since childhood. Syphilis had never been suspected before operation. The interstitial keratitis was cured in three to four months, leaving a large corneal opacity, which reduced vision to 3/60; the eye subsequently developed a secondary cataract, and a rise in ocular tension which required the use of miotics. Four years later she came to Larson for an operation on the right eye. He did an intracapsular extraction without an iridectomy and she made an uneventful recovery, with a final visual acuity of 6/12, because of a congenital choroiditis. The interesting features of the case are the occurrence of congenital cataracts in lues, the role of surgery in initiating an interstitial keratitis, and the favorable postoperative course in the second eye. The latter is attributed to antiluetic therapy, and to the avoidance of trauma to the iris. Larsen believes that trauma is a factor in the etiology of interstitial keratitis. When conditions for its development are favorable, trauma acts as a catalyzer in starting the pathologic process. Ray K. Daily.

Meader, G. and Danis, T. **A new form of corneal dystrophy associated with keratoconus.** Ophthalmologica **114**:246-248, Oct.-Nov., 1947.

The author describes a system of fine "filiform" opacities in the deepest layer of both corneas of a patient with pronounced keratoconus in one eye and a questionable one in the other.

Peter C. Kronfeld.

Mattos, R. B. **Primary complex of conjunctiva.** Arq. brasil. de oftal. **11**:7-9, 1948.

The author describes, in a girl child aged four years, a granulating mass in

the lower palpebral conjunctiva, presenting necrosis and surrounded by cell groups including giant cells and lymphocytes, and to which the diagnosis of productive tuberculuosis was given. The child was placed on treatment with vitamins A and D, in combination with mineral salts, but disappeared from observation too soon for the final result to be recorded. W. H. Crisp.

Moretti, Ezio. **Efficiency of penicillin in herpes zoster; uselessness in interstitial keratitis.** Boll. d'ocul. **26**:717-719, Nov., 1947.

Four illustrative case histories are given to confirm the conclusion mentioned in the title. K. W. Ascher.

Nataf, R. **On the etiology of trachoma.** Arch. d'opht. **7**:589-598, 1947.

In this report Nataf reviews his own previous studies, made with the collaboration of Cúenod, on the etiology of trachoma and answers the criticisms which have been levelled against a number of his conclusions. He considers first his cytological conceptions which center mainly around the term "plastilles" (described as granular formations occurring in the trachoma follicles), and vigorously defends their specific trachomatous nature. He states that they occur only in trachoma but that he is still unable to conclude as to their nature. Other cytological findings which he considers to be of importance include the Prowazek bodies in the conjunctival epithelium and the epithelioid cells of the follicles which show necrotic changes and contain coccobacillary bodies. He concludes that these bodies are identical with those observed in the inclusions of Halberstaedter and Prowazek. He denies that he and his collaborators ever considered Rickettsia Rocha-Lima as the cause of trachoma but states again his belief that the agent of trachoma might be related or adsorbed on to the Rickettsia. He also denies the conclusion attributed to him by certain authors, that the louse was the sole vector and reservoir of trachoma virus but still affirms his belief that the louse could be a possible vector or reservoir of the infection. In support of this hypothesis he reports an experiment in which lice were inoculated with trachomatous material. After three passages in lice, the right conjunctiva of a human volunteer was inoculated with ground louse intestine. A mild follicular conjunctivitis developed and was interpreted by the author as an abortive trachoma. Because of the war he was unable to follow the patient beyond the fourth month.

Nataf concludes that the agent of trachoma is a corpuscular virus intermediate between the ordinary viruses and the rickettsiae and that it appears in such different forms as the elementary and initial bodies of the Prowazek-Halberstaedter inclusion and the rickettsioid bodies. For this agent he proposes the name of Prowazekia trachomatis.

Phillips Thygeson.

Pascheff, C. **New histological proofs of follicular pannus.** Arch. d'opht. **7**:599-603, 1947.

Pascheff reaffirms his previous statements that in the pannus of trachoma there form follicles with germinal centers just like those in the trachomatous conjunctiva. To this pannus rich in follicles he gives the name "follicular pannus." When these follicles become hyperplastic, as a result of proliferation or confluence, they give rise to small hyperplastic tumors which might be called folliculomas. On the cornea this condition can be called folliculomatous pannus. Pascheff concludes that true trachomatous pannus is not an exudative inflammation, nor a simple granulomatous inflammatory process, but that it is a follicular hyperplasia of reticulo-endothelial lymphatic tissue.

He recommends for treatment of follicular pannus either the use of skin grafts or removal of the pannus by superficial keratectomy. Phillips Thygeson.

Venco, L., and Rosso, L. **The evolution of corneal grafts in syphilitic parenchymatous keratitis.** Ann. d'ocul. **181**:199-212, April, 1948.

The most successful results in keratoplasty are obtained in corneas with opacities due to syphilitic parenchymatous keratitis. This is attributable to the minimal vascularization as compared with that in ulcerative diseases. Subsequent uveitis is three times more frequent, however, in syphilitic eyes than in all others combined, due apparently to a toxic reaction from bodily spirochetes. The basic reaction in syphilitic parenchymatous keratitis is largely of the allergic type and is precipitated by a variable trauma to a cornea which contains inactive spirochetes. A complicating cicatrizing uveitis will produce greater corneal opacification and other uveal sequellae. The primary stage of healing involves a traumatic non-granulomatous type of reaction somewhat similar to the traumatic allergic reaction in syphilitic parenchymatous keratitis. Early and slight vascularization favors a local immunity of the transplant against foreign protein reactions. In the second stage the transplant has survived the initial traumatic reaction and the proteins of the host are no longer toxic to the implant. This is followed by slight vascular invasion which bridges the cornea of the host and that of the implant.

Chas. A. Bahn.

8

UVEA, SYMPATHETIC DISEASE, AQUEOUS

Bamatter, F. **Toxoplasmic chorioretinitis.** Ophthalmologica **114**:340-358, Oct.-Nov., 1947.

The paper is based on the clinical and anatomic findings in a premature female infant who during her life of 27 days showed symptoms of encephalomyelitis with hydrocephalus and a large chorioretinal lesion in one eye. This combination of symptoms suggested the diagnosis of toxoplasmosis which was verified by the demonstration (and photomicrography) of the toxoplasma photozoon in the chorioretinal lesions. The baby's twin brother died of severe ulcerative, probably also toxoplasmic, enterocolitis at the age of 30 days. Peter C. Kronfeld.

Cunningham, E. R. **A study of (1) attenuation of the iris root; (2) attachment between the dilatator and ligamentum in the Chinese eye.** Chinese M.J. **66**:22-28, Jan., 1948.

The anterior limiting layer of the Chinese iris is very dense and tough. There are few crypts and hollow spaces. The innermost part of the iris in this case was attenuated and consisted only of the posterior layer of pigment epithelium and a delicate strand connecting the dilatator muscle and the pectinate ligament.

Irwin E. Gaynon.

Richardson, Shaler. **Diffuse malignant melanoma of the iris. Report of two cases.** Tr. Am. Ophth. Soc. **45**:327-342, 1947.

The salient features of this unusual and rare condition are presented in considerable detail and with good illustrations. Two cases of the diffuse type, primary in the iris are reported.

David O. Harrington.

9

GLAUCOMA AND OCULAR TENSION

Elwyn, Hermann. **Nature of glaucoma.** Arch. Ophth. **38**:506-520, Oct., 1947.

According to the author's concept, normal intraocular pressure is maintained in the following manner: There is a unit mechanism consisting of an effector organ

(tissues of the angle of the anterior chamber with Schlemm's canal, the ciliary body and the vessels of the choroid) and a central control from a center in the brain mediated by means of cholinergic nerves of the parasympathetic nervous system. Primitive peripheral regulation is maintained by the activity of the ciliary body and that of the angle of the anterior chamber by means of a constellation of electrolytes. The volume of blood in the choroid is regulated by the vessel walls. The primitive peripheral regulation is not sufficient and is superseded by a central regulation. This central regulation is effected from a center in the brain, probably situated in the brain stem near or in the Edinger-Westphal nucleus.

Glaucoma is a heredoconstitutional functional disease, involving primarily the function of central regulation of the intraocular pressure. When insufficient impulses from the central regulation reach the units of the effector organ, either the constant volume of the blood in the choroidal vessels is increased or the constant volume of the aqueous is increased. The result is glaucoma with a shallow chamber when an increase in the constant volume of blood in the choroidal vessels predominates, or glaucoma with a normal anterior chamber when the increase in the volume of the aqueous predominates. Primary glaucoma is one disease only. Secondary glaucoma is the increase in intraocular pressure which results when the outflow of aqueous or the choroidal blood volume is interfered with by organic changes in the eye.

John C. Long.

Kronfeld, P. C., and McGarry, H. I. **Five year follow-up of glaucomas.** J.A.M.A. **136**:957-965, April 10, 1948.

Glaucoma is divided into early, moderately advanced, and far advanced, depending upon the perimetric findings. The authors report 225 cases of wide angle glaucoma and 100 of narrow angle glaucoma. These cases had remained in their respective states for at least five years.

The course of the disease after normalization of tension showed a strong dependence on the stage of the disease when normalization became effective in wide angle glaucoma. Semi-normalization of tension preserved the existing vision in two-thirds of the patients. The late stage of glaucoma showed a tendency to progress in the wide angle glaucomas in spite of normalization of tension. The center of the visual field seems to exhibit a specific resistance to the glaucoma in these eyes.

The narrow angle glaucomas remain stationary after normalization of tension in approximately 90 percent of the cases. These patients usually presented themselves early. (6 figures, 3 tables.)

H. C. Weinberg.

Posner, A., and Schlossman, A. **Mild glaucoma.** Am. J. Ophth. **31**:679-686, June, 1948. (11 references.)

Snydacker, Daniel. **The prevention of cycloplegic glaucoma.** Am. J. Ophth. **31**: 730-731, June, 1948. (9 references.)

Thomassen, Thore Lie. **The venous tension in eyes suffering from simple glaucoma.** Acta Ophth. **25**:221-241, 1947.

The author reviews the literature and reports his own investigations of 30 glaucomatous eyes. He made 71 series of measurements of the diurnal variation of the intraocular and the episcleral venous tension. The intraocular tension was measured with a tonometer, and the tension of the episcleral veins taken by a modification of Seidel's method. The tension necessary to compress an episcleral vein was measured with a water manometer; the water from the manometer was conducted into a transparent chamber 8 mm. in diameter and 7 mm. deep of

which one side is covered with a thin, nonelastic, soft cellophane paper, which bulges with pressure. Through the chamber the moment of collapse of the vein could be observed, and the tension read on the manometer. A careful analysis of the plotted data shows that the venous tension in the eye is high in proportion to the ocular tension, when the ocular tension is in an increasing phase, it is medium when the ocular tension remains constant, and low when the ocular tension is in a decreasing phase. The changes in the venous tension are primary. Pilocarpine produces a fall first in the venous tension of the eye, then in the ocular tension. The outstanding result of this study is the demonstration of considerable oscillations that arise spontaneously in the venous tension of the eyes and precedes changes in the ocular tension. (7 curves.)

Louis Daily, Jr.

Zaretskaya, R. B. **Intraocular pressure of normal and glaucomatous eyes as affected by accessory light stimuli.** Am J. Ophth. **31**:721-727, June, 1948. (8 figures, references.)

10

CRYSTALLINE LENS

Franceschetti, A. **Congenital cataract due to German measles during pregnancy. The digito-ocular phenomenon.** Ophthalmologica **114**:332-339, Oct.-Nov., 1947.

The literature is reviewed and two pertinent cases are described. In these two, as well as in other cases of complete congenital cataract, the author has observed the "digito-ocular phenomenon," that is a natural tendency of these children to press against their eyeballs with one or several fingers placed against the closed lids close to either the upper or the lower orbital rim. The author recommends surgery at the earliest possible date, before the nystagmus which occurs several months after birth, becomes firmly established. The idea of therapeutic abortion, which is considered a legitimate form of prophylaxis by some, has met opposition on legal, religious and social grounds. For the time being, one should investigate the following possibilities of prophylaxis: vaccination, premarital voluntary contraction of the disease, isolation of the mother during the first three months of pregnancy.

Peter C. Kronfeld.

11

RETINA AND VITREOUS

Ayberk, Nuri F. **Two cases of obstruction of the central artery of the retina treated with Heparin.** Göz Kliniği **5**:129-135, 1947.

One patient who had received inadequate amounts of the drug because enough was not available was not improved. In the other patient the visual acuity improved for light perception to 5/10 after he had received 600 mgms. of Heparin in six days and no other treatment.

F. H. Haessler.

Bedell, A. J. **Ophthalmoscopy and the hypertensive state.** Mississippi Doctor **25**:347-349, April, 1948.

Patients with hypertensive disease in whom the fundus is devoid of retinal edema and shows only moderate blood vessel changes, are favorable for splanchnicectomy. Those with mild retinopathy as evidenced by cotton wool exudates, hemorrhages and narrow arteries with irregular lumen may be done after a thorough study of the response to rest, cold, drugs and kidney function tests. Those with papilledema, fulminating retinopathy and extensive hemorrhages are least likely to be benefited by surgery.

Irwin E. Gaynon.

Bedell, A. J. **The diagnosis of retinoblastoma.** Tr. Am. Ophth. Soc. **45**:282-291, 1947.

Six case histories with description of the ocular signs which led to enucleation in five and in the sixth, to the diagnosis of angiomatosis are presented. Differential diagnosis, the difficulty of early diagnosis, and the implications of birth control in affected families are discussed.

David O. Harrington.

Braveman, B. L., Koransky, D. S., and Kulvin, M. M. **Quinine amaurosis.** Am. J. Ophth. **31**:731-733, June, 1948. (1 figure, references.)

McFarland, C. B. **Vascular changes of the eye associated with diabetes mellitus.** J. Indiana St. M.A. **41**:487-488, May, 1948.

The earliest change is a non-uniform dilatation and tortuosity of the veins of the retina. Small micro-aneurysms occur in the smallest capillaries of the inner nuclear layer and are usually situated beneath the larger retinal vessels and on or near the small perimacular arterioles.

Irwin E. Gaynon.

Pignalosa, G. **Examination of hypermetropic maculas in red-free illumination.** Boll. d'ocul. **26**:672-682, Nov., 1947.

There is no correlation between the degree of hypermetropia and of amblyopia; some eyes with very high hypermetropia may have an excellent visual acuity, and sometimes, in a case of strabismus, the eye with greater hypermetropia may be the leading one and have better acuity than the one with lesser hypermetropia. Among 447 hypermetropic patients examined with the red-free ophthalmoscope of Zeiss, there were 21 patients with abnormal appearence of the yellow spot. In some of them the area of yellow coloration or its intensity was reduced, and in others the macular reflex was modified or missing. All these eyes were more or less amblyopic. The finer structure of the retina in amblyopic eyes is probably altered in all eyes showing a not otherwise explainable diminution of their visual acuity. (4 colored fundus pictures, 1 table, bibliography.)

K. W. Ascher.

Rutherford, C. W. **Hemorrhages of the retina; newer treatment.** J. Indiana St. M.A. **41**:494-495, May, 1948.

Retinal hemorrhages occur because of increased capillary fragility and permeability. Fragility is tested by the method of Göthlin and premeability by the method of McMaster. Rutin decreases capillary fragility. The initial dose of rutin is 20 mg. three times daily and may be increased to 400 mg. daily. It is nontoxic and noncumulative. In venous thrombosis, dicumeral has almost replaced heparin. The patient must be hospitalized, frequent prothrombin time taken, and only after the dosage has been calculated to make the prothrombin time 50 percent normal, can the patient be ambulatory.

Irwin E. Gaynon.

Verhoeff, F. H. **Successful diathermy treatment in a case of recurring retinal hemorrhages and retinitis proliferans.** Tr. Am. Ophth. Soc. **45**:194-201, 1947.

Observations on a patient are reported in considerable detail in whom vision in the right eye was apparently hopelessly lost from vitreous hemorrhage arising from retinal periphlebitis and in whom retinitis proliferans indicated the same fate for the left eye. No improvement had occurred either with tuberculin therapy or with treatment with diazone, and accordingly surface diathermy was applied to the affected region in the left eye. When the reaction had subsided the foci of periphlebitis had apparently subsided and hemorrhages had disappeared. A series of new retinal hemorrhages in the left eye nine months later was treated with diathermy, again successfully, and vision has remained normal.

The author suggests the use of dia-

thermy treatment as a means of establishing communication between retinal and choridal vessels, thus restoring retinal circulation in all cases of impending blindness from retinal vessel obstruction.

David O. Harrington.

Wagener, H. P., Clay, G. E., and Gipner, J. F. **Classification of retinal lesions in the presence of vascular hypertension.** Tr. Am. Ophth. Soc. **45**:57-73, 1947.

This report to the American Ophthalmological Society by the committee on the classification of hypertensive disease of the retina is a comprehensive evaluation of the retinal complications of cardiovascular renal disease with hypertension. In outline form the report deals with the terminology of lesions of retinal vessels, the grading of lesions of retinal arterioles and the terminology of retinopathies associated with vascular hypertension. More detailed consideration is given to lesions of the retinal arterioles, retinal arteries, retinal veins and choroidal arteries and to the retinopathies of acute hypertension, chronic progressive hypertension, terminal malignant hypertension, and the retinopathies of glomerulo nephritis. David O. Harrington.

Weber, E. **The asymptomatic retinal hole.** Ophthalmologica **114**:304-311. Oct.-Nov., 1947.

The asymptomatic hole in the retina, that is, a complete hole without retinal separation, is not as rare as is generally assumed. The author describes four cases of this condition. From the excellent fundus drawings it is evident that chorioretinitic tissue alterations surrounded the tears in at least three of the cases. Jess has recommended immediate operation whereas Amsler advocates observation to determine the natural course of the process (stationary or progressive). The author bases his decision upon the following factors: (1) the condition of the other eye, (2) the position of the tear (tears in the upper half call for early operation), (3) stationary or progressive course of the degenerative retinal changes, (4) presence or absence of detachment of the vitreous, (5) the refractive error and (6) the incidence of degenerative eye conditions in other members of the patient's family.

In the discussion Amsler recommends immediate surgical treatment of complete retinal tears without separation if there are no visible signs of spontaneous demarcation or walling-off of the diseased portion. It happens only very exceptionally that a retinal tear without visible demarcation does not lead to a detachment.

Peter C. Kronfeld.

12

OPTIC NERVE AND CHIASM

Bruetch, W. L. **Surgical treatment of syphilitic primary atrophy of the optic nerves (syphilitic optochiasmatic arachnoiditis).** Arch. Ophth. **38**:735-754, Dec., 1947.

Recent theories have attributed the cause of primary syphilitic atrophy of the optic nerves to optochiasmatic arachnoiditis, and surgical intervention has been recommended. On the basis of a histologic study of 12 cases of syphilitic primary atrophy of the optic nerves, the propriety of surgical intervention is discussed. In four cases of syphilitic atrophy no arachnoidal adhesions were present at all, and in two others the slight arachnoidal thickening could be considered as still within normal limits. In the others there was definite syphilitic arachnoiditis in the optochiasmatic region. Microscopic examination revealed that the thickened arachnoid passed harmlessly over the optic nerves and chiasm, leaving no signs of pressure. Primary syphilitic optic nerve atrophy is essentially the result of an

inflammatory process in the intracranial portion of the optic nerves and in the chiasm. The inflammation has its origin in a basilar syphilitic meningitis, which in some instances produces an optochiasmatic arachnoiditis and in others leaves the basilar arachnoid grossly unaltered. Surgical removal of the arachnoidal adhesions will be of little, if any, benefit because the inflammatory process within the optic nerves and chiasm remains unaltered by the operative procedure. The most efficacious treatment of primary syphilitic optic atrophy is malarial therapy aided by a course of concomitant and subsequent injections of penicillin, with 5,000,000 units in each course.

John C. Long.

Focosi, M. and Grignolo, A. **Two cases of acute optic neuritis occurring in acute, benign lymphocytic meningitis.** Rassegna ital. d'ottal., 17:11-23, Jan.-Feb., 1948.

The authors report two cases of acute optic neuritis developing during attacks of an acute, benign lymphocytic meningitis, one in a man of 31 years, the other in a woman of 23. After discussion of the clinical aspects and the etiology it was assumed that both developed from the same agent, possibly a virus, which had caused the meningitis. It is suggested that the optic neuritis may, at times, be the only evidence of this infection, or that the other symptoms are so slight as to escape observation.

Finally, a group of five other instances of acute optic neuritis without recognizable extraocular symptoms, is described. These developed in the same period during which the first two were seen.

E. M. Blake.

Hamburg, J. **The treatment of toxic amblyopia by raising the oxydative cell metabolism.** Ophthalmologica 114:358-368, Oct.-Nov., 1947.

The oxygen consumption of the optic nerve in a state of early ascending or descending degeneration after mechanical trauma (in cats) is markedly lower than under normal conditions. In acute or chronic poisoning with quinine or methyl alcohol the oxygen consumption of the retina of cold-blooded animals has been found diminished. On this and similar evidence the author bases his concept that the mechanism of most forms of toxic amblyopia is a specific diminution of the oxydative cell metabolism, caused by the direct action of the toxic substance on nerve tissue. Specific treatment of toxic amblyopia should, therefore, consist of abstinence, the administration of a high-caloric diet with large amounts of vitamin B and an oxydation-raising agent. For the latter purpose the author uses manganese chloride in 0.02 molar solution in daily doses of from 1 to 3 cc. (intramuscularly). Manganese intoxication can be prevented by watching the pulse rate which should not go up more than 10 beats per minute. Several cases of combined alcohol-nicotine amblyopia were first treated with total abstinence plus high-caloric, high-vitamin diet for several weeks. If only minimal improvement in visual acuity occurred the manganese treatment was instituted. In three such cases the visual acuity started to improve "almost suddenly" on the fourth to sixth day of the manganese therapy.

In the discussion F. P. Fischer reports negative results with a similar, cell metabolism-raising treatment by means of intramuscular injections of potassium permanganate (1 cc. of a one-percent solution) in cases of "camp eyes."

Peter C. Kronfeld.

Lin, Chang-yuin, and Tao, Kuo-tai. **Neuromyelitis optica in a Chinese.** Chinese M.J. 66:18-25, Jan., 1948.

A case of neuromyelitis optica in a 25-year-old woman is presented. Within a few days she lost light perception in

both eyes. Three and seven years later the patient developed myelitis in the form of a brown sequard syndrome. There was a complete remission of spinal symptoms between attacks. Irwin E. Gaynon.

Man, H. X. **Diagnostic etiology of a case of unilateral optic atrophy.** Ann. d'ocul. **181**:106-110, Feb., 1948.

A 22-year-old man with a primary optic atrophy in the left eye only, had noted gradual failing sight for two years. The right pupil was somewhat larger, but both direct and indirect light reactions were normal in both eyes. The fields were normal, except for a concentric contraction to one-half in the left eye and a bitemporal chromatic contraction in both eyes. Radiographically, the sella appeared abnormally calcified. In addition to failing vision the patient had also noticed increased somnolence and decreased virility during two years. Otherwise he was clinically and serologically normal, except for slight clinical indications of hypothyroidism and sexual hypopituitarism. After cystic drainage and partial removal of an intrasellar craniopharyngioma the bitemporal chromatopsia improved. The differential diagnosis of the mechanism that produces monocular primary optic atrophy with bitemporal chromatopsia is discussed at some length.

Chas. A. Bahn.

Missiroli, Giuseppe. **A new congenital familial syndrome: hypoplasia of the optic nerve and binasal hemianopia.** Boll. d'ocul. **26**:683-698, Nov., 1947.

Two daughters and one son showed the syndrome named in the title. In otherwise normal eyes of physically normal individuals, the optic nerves showed an extremely small diameter, about one-fourth of the usual size, sharp outlines, and normal color. There were no other children in this family, and both parents had normal eyes, and there was no consanguinity of the parents. Similar but not identical cases have been previously reported by Schwarz (1915) and Velhagen (1930) (1 colored fundus picture, 2 visual fields, bibliography.) K. W. Ascher.

Verzella, M. **The injection of nicotinic acid "juxta forum opticum" in some forms of optic neuritis.** Rassegna ital. d'ottal., **17**:24-77, Jan.-Feb., 1948.

Since 1937, when Goldberg isolated nicotinic acid and its amide from a liver extract, there has been much effort to explain the complex biological action of this substance. Of particular interest to the ophthalmologist is the effect upon the blood vessels, especially the arterioles, capillaries and venules. Here its action has been seen to produce hyperemia, increased velocity of the blood stream, with resulting increased oxidation. Condorelli has suggested that these results are due to stimulation of the cerebrospinal vegetative centers. Intramuscular injection of 60 mmgr. of nicotinic acid produces a dilatation of the retinal veins lasting 45 minutes.

Verzella gives minute directions for the introduction of the hypodermic needle into the orbit so that the solution of nicotinic acid is made close to the optic foramen. Ten injections of 15 mmgr. were given in each orbit. Sixteen patients, with various types of optic nerve disease were treated, eleven with very good results. An elaborate discussion of the action of the nicotinic acid, especially at the site of injection, follows. (18 figures)

E. M. Blake.

NEWS ITEMS

Edited by DONALD J. LYLE, M.D.
601 Union Trust Building, Cincinnati 2

News items should reach the editor by the 12th of the month

ANNOUNCEMENTS

ARGENTINA CONGRESS MEETS IN DECEMBER

The 4th National Argentinian Congress of Ophthalmology will convene in Mar del Plata, a beach resort 250 miles south of Buenos Aires, from December 13 to 18, 1948. The congress meets every four years. Prof. Diego M. Arguello is president and any correspondence concerning the meeting should be addressed to him at Casilla Correo 4097, Buenos Aires.

WANTED

The Ophthalmic Publishing Company will pay $1.50 for copies of the January, 1947, and January, 1948, numbers of the *American Journal of Ophthalmology*. Send copies to the Manager of Subscriptions, Ophthalmic Publishing Company, 664 North Michigan Avenue, Chicago 11, Illinois.

CALIFORNIA POSTGRADUATE COURSE

A postgraduate course in ophthalmology will be given by the University of California Medical School, September 6th through 11th. The course, under the direction of Dr. Frederick C. Cordes, will be held at Toland Hall, University of California Hospital, San Francisco.

Officers of instruction include the following:

Dr. Samuel D. Aiken, Dr. Crowell Beard, Dr. George S. Campion, Dr. Frederick C. Cordes, Dr. Joseph W. Crawford, Dr. C. Allen Dickey, Dr. Owen C. Dickson, Dr. David O. Harrington, Dr. Margaret Henry, Dr. Michael J. Hogan, Dr. Warren D. Horner, Dr. Robert N. Shaffer, Dr. Joseph G. Smith, and Dr. Phillips Thygeson.

On Friday evening, September 10th, the third annual Francis I. Proctor Lecture will be delivered by Dr. David G. Cogan, associate professor of ophthalmic research and director of the Howe Laboratory of Ophthalmology, Harvard University Medical School. His subject will be "The Physio-Pathologic Basis for Some of the Signs and Symptoms of Corneal Disease."

The schedule of classes is:

Monday, September 6

8:30-8:40 a.m.—Opening Address—*Dr. Cordes*
8:40-9:30 a.m.—Diagnosis and Treatment of Blepharo-Conjunctivitis—*Dr. Crawford*
9:45-10:45 a.m.—Practical Observations in Refraction, Part I—*Dr. Cordes*
11:00-12:00 noon—Practical Observations in Refraction, Part II—*Dr. Cordes*
1:30-2:30 p.m.—Thyrotropic and Thyrotoxic Exophthalmos—*Dr. Dickson*
2:45-3:45 p.m. Emergency Treatment of Eye Injuries—*Dr. Smith*
4:00-5:00 p.m.—Diagnosis and Pre-Operative Management of Retinal Detachment—*Dr. Dickson*

Tuesday, September 7

8:30-9:30 a.m.—Optic Atrophies in Children and Adults—*Dr. Dickson*
9:45-10:45 a.m.—Etiology and Treatment of Uveitis, Part I—*Dr. Thygeson*
11:00-12:00 noon—Etiology and Treatment of Uveitis, Part II—*Dr. Thygeson*
1:30-2:30 p.m.—Congenital Ocular Anomalies—*Dr. Henry*
2:45-3:45 p.m.—Diagnosis and Management of Lid and Conjunctival Tumors—*Dr. Hogan*
4:00-5:00 p.m.—Preparation, Sterilization, and Care of Ophthalmic Solutions—*Dr. Hogan*

Wednesday, September 8

8:30-9:30 a.m.—The Office Treatment of External Diseases—*Dr. Horner*
9:45-10:45 a.m.—X-ray Localization of Intraocular Foreign Bodies—*Dr. Smith*
11:00-12:00 noon—Routine Testing of Eye Muscles (Demonstration)—*Dr. Dickey*
1:30-2:30 p.m.—Congenital Anomalies of the Eye Muscles—*Dr. Campion*
2:45-3:45 p.m.—Diagnosis and Treatment of Paralytic Squint—*Dr. Dickey*
4:00-5:00 p.m.—Physiology of the Extraocular Muscles—*Dr. Campion*

Thursday, September 9

8:30-9:30 a.m.—Pediatric Ophthalmology—*Dr. Henry*
9:45-10:45 a.m.—Neuro-Ophthalmology, Part I—*Dr. Harrington*
11:00-12:00 noon—Neuro-Ophthalmology, Part II—*Dr. Harrington*
1:30-2:30 p.m.—Medical Ophthalmology, Part I—*Dr. Aiken*
2:45-3:45 p.m.—Medical Ophthalmology, Part II—*Dr. Aiken*
4:00-5:00 p.m.—The Importance of the Pupil in Diagnosis—*Dr. Beard*

Friday, September 10

8:30-9:30 a.m.—Diagnostic and Differential Diagnostic Problems in Early Glaucoma—*Dr. Cordes*
9:45-10:45 a.m.—Glaucoma, Part I—*Dr. Shaffer*
11:00-12:00 noon—Glaucoma, Part II—*Dr. Shaffer*
1:30-2:30 p.m.—Ocular Allergies—*Dr. Crawford*
2:45-3:45 p.m.—Toxoplasmosis—*Dr. Hogan*
4:00-5:00 p.m.—Virus Diseases of the Cornea—*Dr. Thygeson*

Saturday, September 11

8:30 a.m.—Clinical Conference—*Dr. Cogan*

This course is open only to qualified physicians and requests for registration should be addressed to:

Dr. Stacy R. Mettier, Medical Extension, University of California Medical Center, San Francisco 22. The fee for the course is $60.00 payable at the time of enrollment.

Miscellaneous

Luncheon for Journal staff

The editorial staff and collaborators of the Journal were entertained at a luncheon given by the Ophthalmic Publishing Company at the Kungsholm restaurant, Chicago, on June 24th.

Those present were: Dr. Charles A. Bahn, New Orleans; Dr. Alston Callahan, Birmingham; Mrs. Katherine Chalkley, Lake Geneva; Dr. F. M. Crage, Chicago; Dr. Beulah Cushman, Chicago; Dr. Ray K. Daily, Houston; Dr. Orwyn H. Ellis, Los Angeles; Dr. Irwin E. Gaynon, Milwaukee; Dr. and Mrs. F. Herbert Haessler, Milwaukee; Dr. Max Hirschfelder, Centralia, Illinois; Dr. Peter C. Kronfeld, Chicago; Dr. Donald J. Lyle, Cincinnati; Dr. William A. Mann, Chicago; Dr. Lawrence T. Post, Saint Louis; Dr. A. B. Reese, New York; Dr. Ernst Schmerl, Toledo; Dr. Theodore M. Shapira, Chicago; Mrs. Mildred Skinner, Chicago; Dr. Phillips Thygeson, San Jose, California; Dr. Derrick Vail, Chicago; and Dr. Alan C. Woods, Baltimore.

Lions Club scholarships

At a luncheon at the Savoy Plaza Hotel, New York, on June 2nd, the Lions Club of New York presented a check for $2,000 to the New York University College of Medicine to finance four scholarships for graduate training in ophthalmology.

The scholarships were awarded to Dr. Goodwin M. Breinin and Dr. Walter J. Maher of New York, Dr. Edwin H. Kent of Riverside, Connecticut, and Dr. Charles H. Toomey of Lakewood, Ohio. They will study special phases of eye conservation at Bellevue Hospital under the direction of Dr. Daniel B. Kirby, chairman of the ophthalmology department at the College of Medicine.

Honored guests at the luncheon were: Mr. William E. Cotter, guest speaker; Mr. Benet Polikoff, president of the Lions Club; Dr. E. M. Bernecker, commissioner of city hospitals; Mr. E. R. Fryxell, chairman of the Eye Conservation Committee of the Lions Club; Dr. Currier McEwen, dean of the New York University College of Medicine; Dr. Daniel B. Kirby, professor of ophthalmology, New York University College of Medicine; Dr. Townley Paton, technical adviser for the Eye-Bank for Sight Restoration, Inc.; Dr. F. M. Foote, director of the National Society for the Prevention of Blindness; Mrs. Grace Harper, director for the Bureau of Service for the Blind, New York; Dr. Philip S. Platt, executive director, New York Association of Blind.

Societies

Research Association scientific program

The Association for Research in Ophthalmology, Inc., met at Thorne Hall, Northwestern University Medical School, Chicago, on June 21st and 22nd. The program follows:

Monday, June 21

Alston Callahan, M.D.———Aniridia, Ectopic Lenses, and Congenital Glaucoma: Genetic, Pathologic, and Surgical Considerations

Harold F. Falls, M.D.———A Gene Producing Various Defects of the Anterior Segment of the Eye

William T. Kruse, M.D., Harold F. Falls, M.D. ———Three Cases of Marcus-Gunn Phenomenon in Two Generations

Harold G. Scheie, M.D., Jerome Bourne, M.D. ———Electrocoagulation of the Sclera: Reduction in Ocular Volume and Pathological Changes Produced

J. Lloyd Burns, M.D., W. Stanley Hartroft, M.D. ———Intraocular Hemorrhage in Young Rats on a Choline-Deficient Diet

Edward P. Danforth, M.D.———The Fate of Transplanted Ciliary Body Tissue

R. K. MacDonald, M.D.———Changes Observed in the Eyes of Animals Following Prolonged Administration of Testicular Extract

Donald T. Hughson, M.D.———The Use of Alkyldimethyl-benzyl Ammonium Chloride for Maintenance of Sterility in Solutions

Dorland J. Davis, M.D., Margaret Pittman, Ph.D. ———Streptomycin in the Treatment of Experimental Conjunctivitis due to *Hemophilus sp.*

Murray Sanders, M.D., Alson Braley, M.D.——— Aureomycin in Ocular Infections, A Study of Its Spectrum

J. K. Frenkel, M.D.———Uveitis and Toxoplasmin Sensitivity

John C. Locke, M.D.———Experimental Studies with Antibiotics (Bacitracin, Streptomycin, Penicillin) and Antibiotic Mixtures in Intraocular Infections with Penicillin-resistant Staphylococci

Henry A. Imus, Ph.D., Lt. Comdr. (MC) U.S.N.R. ———Industrial Vision Testing Techniques

Tuesday, June 22

Irving H. Leopold, M.D., Joseph Smolens, Ph.D., James H. Parker, Jr., M.D.———Some Physical, Chemical, and Biological Properties of Normal Human Tears

Frank W. Newell, M.D., John A. D. Cooper, M.D., Chester J. Farmer, M.D.———Effect of BAL (2, 3 Dimercaptopropanol) on Intraocular Copper

John E. Harris, Ph.D., Leta Gehrsitz, M.S.——— Movement of Monosaccharides into and out of the Aqueous Humor

V. Everett Kinsey, M.D., Ernst Barany, M.D.——— The Rate of Flow of Aqueous Humor and its Significance for Intraocular Fluid Problems

Jonas S. Friedenwald, M.D.———Proctor Address: Formation of the Aqueous

T. D. Duane, M.D.———The Steady State of Corneal Hydration

W. A. Robbie, Ph.D., P. J. Leinfelder, M.D.——— The Use of Isolated Retinal Tissue in Studies of the Metabolism of the Central Nervous System

Lawrence Ely, M.D.———Respiration of the Crystalline Lens

Paul W. Miles, M.D.———Flicker Fusion Frequency in Amblyopia ex Anopsia

John W. Henderson, M.D., Ph.D.———The Anatomical Basis for Certain Reflex and Automatic Eye Movements

K. W. Ascher, M.D.———The Compression Test of Aqueous Veins of Glaucomatous Eyes

Section on Ophthalmology program

The Section on Ophthalmology, American Medical Association, met at Thorne Hall, Northwestern University, Chicago, on June 23rd, 24th, and 25th, under the chairmanship of Dr. Everett L. Goar, Houston, Texas.

The program included: Chairman's Address, with lantern demonstration, Dr. Everett L. Goar; Address, Dr. John A. MacMillan, Montreal, Canada; "Retrolental Fibroplasia and Persistent Hyperplastic Primary Vitreous: Two Entities," Dr. A. B. Reese, New York; "The Epidemiology of Encephalo-Ophthalmic Dysplasia," Dr. Theodore H. Ingalls, Southborough, Massachusetts; "Treatment of Glaucoma Associated with Iridocyclitis," Dr. Adolph Posner and Dr. Abraham Schlossman, New York; "The Use of Strips of Orbicularis Oculi Muscles in Surgery of the Eyelids," Dr. William B. Clark, New Orleans; "Verified Refraction," Dr. S. Judd Beach, Portland, Maine; "Intraorbital Tumors," Dr. Arnold W. Forrest, New York; "The Use of D.F.P. in Glaucoma," Dr. P. Robb McDonald and Dr. Irving H. Leopold, Philadelphia; "The Blindspot Syndrome," Dr. Kenneth C. Swan, Portland, Oregon; "Nonmedical Problems in Industrial Ophthalmology," Dr. Ralph S. McLaughlin, Charleston, West Virginia; "The Use of Streptomycin and Streptomycin Plus Promizole in Experimental Ocular Tuberculosis," Dr. Alan C. Woods, Baltimore; "A Method of Retrobulbar Anesthesia which Produces an Associated Muscle Block of the Extraocular Muscles," Dr. Harold Gifford, Jr., Omaha, Nebraska; "Basic Principles of Ocular Muscle Surgery," Dr. Watson Gailey, Bloomington, Illinois; "A Further Exceedingly Delicate Test for Astigmatic Axis," Dr. William H. Crisp, Denver, and Dr. George H. Stine, Colorado Springs.

Scientific exhibits at A. M. A. convention

The Section on Ophthalmology exhibits at the A.M.A. convention included: "New Type Movable Implant," by Dr. William Stone, Jr., Massachusetts Eye and Ear Infirmary, Boston, awarded the bronze medal; "Tumors of the Orbit," Dr. Raymond G. Ingalls, Institute of Ophthalmology, Presbyterian Hospital, New York; "Diseases of the Fundus Oculi," Dr. Bertha A. Klien, Department of Ophthalmology, Northwestern University Medical School, Chicago, awarded the gold medal; "Prevention of Ophthalmic Neonatorum: Antibiotics Replace Silver Nitrate," Dr. Louis Lehrfeld, Wills Eye Hospital, Philadelphia; "Treatment of Ocular Infections: Use of Chemotherapeutic Agents," Dr. John G. Bellows and Dr. Chester J. Farmer, Northwestern University Medical School, Chicago, awarded the certificate of merit; "Ocular Toxoplasmosis: Clinical Observations," Dr. Lorand V. Johnson, Western Reserve University School of Medicine, Cleveland; "Observations on the Course of Glaucoma," Dr. Adolph Posner and Dr. Abraham Schlossman, New York.

Better Vision Institute officers

At the annual meeting of the Better Vision Institute the following men were chosen to serve two-year terms ending in June, 1950: manufacturers—Beverly Chew, J. E. Hansen, B. A. Ramaker, G. B. Wells; supply house representatives—T. A. Byrne, Roy Martin, L. W. Myers, C. N. Shelden; optometrists—John F. Hill, John Hughes, W. E. Malinka, J. A. Palmer; ophthalmic dispensers—W. A. Blocker, William Cook, J. A. T. Obrig, A. F. Weber.

At the meeting of the board of directors, officers and members of the executive committee were elected for one-year terms as follows: officers—M. J. Julian, president; E. E. Williams, treasurer; Carl Hallauer, George Nagel, Roy Martin, H. B. Carpenter, and John F. Hill, divisional directors; executive committee—M. J. Julian, chairman; E. E. Williams, Herbert Eisenhart, C. N. Shelden, John F. Hill, and J. A. T. Obrig.

Reading meeting

The 82nd meeting of the Reading Eye, Ear, Nose, and Throat Society was held June 9th. It consisted of surgical and dry eye and ear, nose and throat clinics. The speakers were Dr. F. L. Philip Koch, chief surgeon, Glaucoma Clinic, Manhattan Eye and Ear Hospital, New York, who spoke on "Glaucoma"; Dr. Karl M. Houser, professor of otology, University of Pennsylvania, who spoke on "The Diagnosis and Treatment of Meniere's Disease." There was a study club conducted by Dr. Robert R. Impink, chief of general surgery, St. Joseph's Hospital, on "General Principles of Surgery."

Carolinas meeting

The South Carolina Society of Ophthalmology and Otolaryngology and the North Carolina Eye, Ear, Nose, and Throat Society will hold a joint meeting in Charleston, South Carolina, from September 13th through 16th. Headquarters will be at the Francis Marion Hotel. Invitations will be sent to specialists in Virginia, Tennessee, Georgia, and Florida. The first two days of the meeting will be devoted to ophthalmology; the last two days to otolaryngology.

Personals

Awarded Lucien Howe prize

Dr. Jonas S. Friedenwald of Baltimore, has been awarded the Lucien Howe Prize in Ophthalmology by the University of Buffalo for his basic research work in ophthalmology. The prize is awarded only when, in the opinion of the committee, a man is worthy of such recognition. It has been several years since the last award was made.

PAN-AMERICAN NOTES

Edited by M. URIBE TRONCOSO, M.D.
500 West End Avenue, New York 24

Communications should reach the editor by the 12th of the month

SYMPOSIUM ON OCULAR ONCHOCERCOSIS

The Mexican Ophthalmological Society, with the coöperation of some foreign oculists, held a symposium on onchocercosis on August 5, 1947. Guests were: Dr. Thomas R. Yanes and Dr. Miguel A. Branly of Cuba and Dr. R. Pacheco Luna of Guatemala. The papers read were: "A brief history of the Mexican Society of Ophthalmology and its journal, *Anales de Oftalmologia*," Dr. R. A. Chavira; "History of onchocercosis, especially in Guatemala," Dr. R. Pacheco Luna; "Parasitology of onchocercosis," Dr. L. Mazotti; "Transmission of the disease," Dr. Luis Vargas; "Synthesis of the studies on the entomology of onchocercosis," Dr. I. Ochoterena; "Cutaneous lesions in the disease and frequency of blindness as a complication," Dr. L. Benitez Soto: "Histopathological examination of the affected eyes," Dr. Bertha Riveroll; "Report of a trip through the zone where the disease is prevalent," Dr. R. Nettel; "The presence of microfilaria in the human eye and the tissue changes which it produces," Dr. A. Torres Estrada; "New statistics on the frequency of onchocerosis," Dr. M. Puig Solanes.

At the conclusion of the meeting several members brought up the idea of founding a Pan-American society of tropical ophthalmology. The idea was discussed and approved, and a committee was formed to organize the society. On the committee are Dr. Pacheco Luna, Dr. Puig Solanes, and Dr. Palomino Dena.

IV PAN-AMERICAN CONGRESS OF OPHTHALMOLOGY

This congress will convene in Mexico City in January, 1952. The ophthalmological societies in Mexico sent representatives to a meeting at which the organization and preliminary work were started. A permanent committee was appointed: President, Dr. A. Torres Estrada; vice-president, Dr. M. Puig Solanes; general secretary, Dr. L. Sanchez Bulnes; treasurer, Dr. F. Palomino Dena; secretary of scientific activities, Dr. Raul A. Chavira; secretary of surgical activities, Dr. Lino Vergara Espino; secretary of organization; Dr. F. Martinez Hinojosa; secretary of propaganda, Dr. Teodulo Agundis; secretary of social activities, Dr. Daniel Silva; secretary of technical exhibits, Dr. M. Rivas Cherif; director of courses, Dr. Abelardo Zertuche. The official address of the committee is: Dr. A. Torres Estrada, Gomez Farias No. 16, Mexico, D.F.

FIRST NATIONAL CONGRESS OF OPHTHALMOLOGY IN MEXICO

This congress will convene from January 9 to 15, 1949. The committee has made the following appointments: Honorary presidents: Dr. Manuel Uribe Troncoso, Dr. Manuel Marquez, Dr. Antonio F. Alonso, Dr. Ricardo Tapia Fernandez, and Dr. Carlos Bauer; president, Dr. Lino Vergara Espino; vice-president, Dr. Raul Arturo Chavira; general secretary, Dr. M. Puig Solanes; treasurer; Dr. F. Palomino Dena; secretary of scientific activities, Dr. A. Torres Estrada; secretary of technical exhibits, Dr. M. Rivas Cherif; director of courses, Dr. Abelardo Zertuche. Addresses are as follows: Dr. Lino Vergara Espino, president, 5 de Mayo No. 40-106, Mexico, D.F., and Dr. M. Puig Solanes, general secretary, Av. Lopez Cotilla No. 811, Mexico, D.F.

PROCEEDINGS OF THE II PAN-AMERICAN CONGRESS OF OPHTHALMOLOGY

The Transactions of the II Pan-American Congress have been published in Montevideo under the editorship of Dr. A. Vazquez Varriere and Dr. R. Rodriguez Barrios. The three well-printed and illustrated volumes contain all the papers and discussions presented to the congress and also a brief history of the foundation and development of the I and II Pan-American meetings.

PERSONALS

Dr. Moacyr Alvaro, of Sao Paulo, Brazil, read a paper on "Pathogenesis of Uveitis" before the Mexican Ophthalmological Society.

Dr. David C. Cogan of Harvard University gave a series of lectures on physiopathology of the cornea in Mexico City, under the auspices of the Mexican Ophthalmological Society.